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## ABSTRACT

This technical specialty course is one of thirty-five courses designed for use by two-year postsecondary institutions in five nuclear technician curriculum areas: (1) radiation protection technician, (2) nuclear instrumentation and control technician, (3) nuclear materials processing technician, (4) nuclear quality-assurance/quality-control technician, and (5) nuclear reactor (plant) operator trainee. This course, Quality-Assurance Practices, contains eight modules: Overall Quality Assurance Program; Vendor Qualification; Receiving Inspection; Identification, Storage, and Handling of Components, Parts, and Materials; Non-Conforming Materials; Certification and Qualification of Quality Control Inspectors; Auditing for Quality Assurance; and Document Handling, Storage, and Retrieval for Quality Assurance. Each module follows a typical format including the following sections: introduction, module prerequisites, objectives, subject matter, exercises, materials, procedures, data tables, reference materials, and tests. (A master index and suggested program planning guides are also available--see CE 026 856 and CE 026 639-643.) (LRA)

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ED192113

Nuclear Technology Series

**COURSE 31**  
**QUALITY-ASSURANCE**  
**PRACTICES**

**CENTER FOR OCCUPATIONAL RESEARCH**  
**AND DEVELOPMENT, INC.**

**4800 LAKEWOOD DRIVE**  
**WACO, TEXAS 76710**

**AUG 1980**

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## P R E F A C E

### ABOUT NUCLEAR TECHNOLOGY MODULES

The modules - developed for use in two-year postsecondary technical institutions to prepare technicians for employment - are useful in industry for updating employees in company-sponsored training, and as laboratory texts in engineering schools. The principles, techniques and skills taught in the modules, based on tasks that nuclear technicians perform, were obtained from a nationwide advisory committee of employers of nuclear technicians. Each module was written by a working technical expert/experienced writer team and tested with students.

A module contains the following elements:

Introduction, which identifies the topic and often includes a rationale for studying the material.

Module Prerequisites, which identify the material a student should be familiar with before studying the module.

Objectives, which clearly identify what the student is expected to know for satisfactory module completion. The objectives, stated in terms of action-oriented behaviors, include such action words as operate, measure, calculate, identify and define, rather than words with many interpretations, such as know, understand, learn and appreciate.

Subject Matter, which presents the background theory and techniques supportive to the objectives of the module. Subject matter is written with the technical student in mind.

Exercises, which provide practical problems to which the student can apply this new knowledge.

Materials, which identify the equipment required to complete the laboratory procedure.

Procedures, which is the experiment section, or "hands-on" portion of the module (including step-by-step instruction) designed to reinforce student learning.

Data Tables, which are included in most modules for the first year (or basic) courses to help the student learn how to collect and organize data.

Reference Materials, which are included as suggestions for supplementary reading/viewing for the student.

Test, which measures the student's achievement of the pre stated objectives.

A helpful Index has been added at the end of each course.

The materials contained herein were developed pursuant to a contract with the Office of Education, U.S. Department of Health, Education and Welfare: Contract No. 300780582. Contractors undertaking such projects under Government sponsorship are encouraged to express freely their professional judgment in the conduct of the project. Points of view or opinions stated do not, therefore, necessarily represent official Office of Education position or policy.

The Nuclear Technology Series consists of five curricula:

Nuclear Reactor (Plant) Operator Trainee.  
Radiation Protection Technician.  
Nuclear Materials Processing Technician.  
Nuclear Quality-Assurance/Quality-Control Technician.  
Nuclear Instrumentation and Control Technician.

The completed Nuclear Technology Series consists of the following 35 technical specialty courses:

|                                                               |                                                     |
|---------------------------------------------------------------|-----------------------------------------------------|
| Radiation Physics.                                            | Radiological Emergencies.                           |
| Radiation Protection I.                                       | Radiation Shielding.                                |
| Principles of Process Instrumentation.                        | Radiation Monitoring Techniques<br>(Radiochemical). |
| Heat Transfer and Fluid Flow.                                 | Radioactive Materials Disposal and<br>Management.   |
| Introduction to Nuclear Systems.                              | Advanced Radionuclide Analysis.                     |
| Instrumentation and Control of<br>Reactors and Plant Systems. | Nuclear Chemical Processes.                         |
| Reactor Operations.                                           | Nuclear Systems and Safety.                         |
| Reactor Safety.                                               | Radioactive Material Handling Techniques.           |
| Reactor Auxiliary Systems.                                    | Nondestructive Examination (NDE)<br>Techniques I.   |
| Power Plant Systems.                                          | Metrology.                                          |
| Radiation Detection and Measurement.                          | Welding Inspection.                                 |
| Reactor Physics.                                              | Civil/Structural Inspection.                        |
| Power Plant Chemistry.                                        | Mechanical Inspection.                              |
| Introduction to Quality Assurance/<br>Quality Control.        | Quality-Assurance Practices.                        |
| Metallurgy and Metals Properties.                             | Nondestructive Examination (NDE)<br>Techniques II.  |
| Mechanical Component Characteristics<br>and Specifications.   | Control Systems I.                                  |
| Radiation Protection II.                                      | Control Systems II.                                 |
|                                                               | Power Plant Electrical Systems and<br>Components.   |

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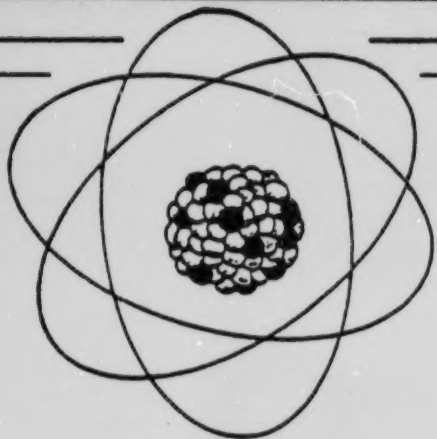
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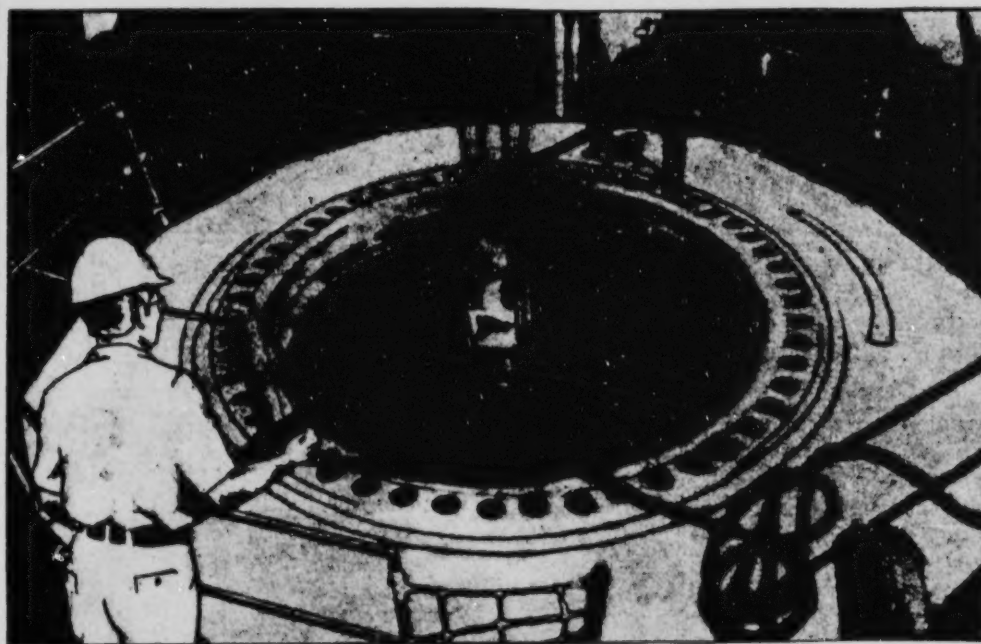




# NUCLEAR TECHNOLOGY

## MODULE 31-1

### OVERALL QUALITY ASSURANCE PROGRAM



## COURSE 31 QUALITY ASSURANCE PRACTICES



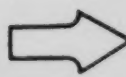
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## COURSE MODULES

### COURSE 31      QUALITY ASSURANCE PRACTICES

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## INTRODUCTION

The Nuclear Quality Assurance/Quality Control Technician may be assigned to a variety of duties within the overall quality assurance program. Many companies view the technician as a "quality engineer in training". Accordingly, a career development pattern is often associated with assignments to the technician.

The Quality Assurance Program applicable to a Nuclear Power Station encompasses design, construction and operation. The program starts with the nuclear utility and extends to all contractors and consultants to the utility. In each specific application, the extent of quality assurance requirements are specified in purchase orders with contractors and consultants. In turn, contractors and consultants specify in their purchase orders with lower-tier vendors the applicable quality assurance requirements.

This module describes the applicant's responsibility for quality assurance and identifies how quality assurance requirements are passed on to other organizations. In addition, this module defines the three phases of activities of the plant: design, construction, and operations. It gives insight on the pyramiding effect of the quality assurance program as it applies to contractors. Finally, this module reviews the eighteen criteria applicable to the quality assurance program and relates these criteria to technical requirements.



## MODULE PREREQUISITES

The student shall have completed Course 14 - Introduction to Quality Assurance and Quality Control.



## OBJECTIVES

Upon completion of this module, the student/trainee can:

1. Identify the regulatory source for quality assurance requirements applicable to nuclear power plants and name the two principal ANSI standards which provide standards for implementation of regulatory requirements.
2. Relate the application of ANSI quality assurance standards to the design, construction and operations phases of a nuclear power plant.
3. Describe how quality assurance requirements are applied to a contractor at any tier from the owner.
4. Briefly describe the applicable requirements of 10CFR50 Appendix B when given the name of any of the eighteen criteria therein.
5. State the purpose of the ANSI N45.2 series of supplementary standards.
6. Describe how the effectiveness of a quality assurance program may be judged.
7. Describe typical rationale for determining the quality assurance requirements to be placed in a contract for product or services.



## NOTES TO INSTRUCTOR / STUDENT

Advance preparation is necessary for the activities described by this module. Activity #1 requires the availability of reference materials listed within the activity. Activity #2 requires use of Quality Assurance Manuals. Such manuals may be obtained from nearby nuclear industries. Either of these activities may be modified as necessary to adapt them to local circumstances.





# SUBJECT MATTER

## QUALITY ASSURANCE PROGRAM

### Source of Requirements

The U.S. Code of Federal Regulations, Title 10, Part 50 (10 CFR 50) requires each applicant of a construction permit or operating license for a nuclear power plant to develop and implement a quality assurance program that meets the eighteen criteria given by Appendix B of 10 CFR 50. The quality program is developed very early in the planning for a nuclear power plant and is implemented as applicable at the start of the design of the plant. The Nuclear Regulatory Commission (NRC) reviews the applicant's quality assurance program in conjunction with reviewing the application for a Construction Permit and the subsequent application for an Operating License. Without an adequate quality assurance program, a nuclear power plant would not be built, much less operated.

### Definition and Application

Quality Assurance is defined by Appendix B to 10 CFR 50 as comprising "all those planned and systematic actions necessary to provide adequate confidence that a structure, system, or component will perform satisfactorily in service".

Application of this broad definition to a given activity can be considered as pertaining to two elements of every activity. The first element consists of the "doing" part of the activity and the second element is the "checking" part of the activity. Hence "all those planned and systematic actions necessary..." include actions by the "doer" and the "checker". A more difficult portion of the definition is the determination of what is "necessary". For illustration, consider the driver of an automobile. Driving the car is the doing aspect. Checks can consist of examina-

tions of operator's license, vehicle inspections, posted highway signs, road design (e.g. limited access, radii of curves, etc.), and police operated radar speed monitors. Notice that one could argue the merits of each check in terms of whether it is necessary for the doing aspect of driving a car. Also notice that "driving a car" implies safe driving. The question becomes "will the check result or tend to result in safe driving?"

Essentially uniform application of the definition of quality assurance is guided by (1) regulations, codes, standards, and specifications, (2) overall responsibility vested in the owner, and (3) technical significance in terms of safe operations. Each of these are further discussed as follows:

- Regulations, Codes, Standards, and Specifications - Principal guidance for the quality assurance program is contained in these documents. Beginning with 10 CFR 50 and Appendix B thereto, NRC issues Regulatory Guides that give more specific criteria than contained in 10 CFR 50, Appendix B. Examples include Regulatory Guide 1.23, Quality Assurance Program Requirements (Design and Construction) and Regulatory Guide 1.33, Quality Assurance Program Requirements (Operation). These Regulatory Guides in turn reference even more specific commercial codes and standards which are acceptable to NRC such as:
  - (1) American National Standards ANSI N45.2, Quality Assurance Program Requirements for Nuclear Power Plants and
  - (2) ASME Boiler and Pressure Vessel Code.From these regulations, codes, and standards, design activities result in the preparation of system and component specifications which detail the plant design in compliance with applicable regulations, codes, and standards.

- Overall Responsibility Vested in the Applicant - The applicant for construction and operation of the nuclear power plant (typically the owner of the plant) has total, overall responsibility for the quality assurance program no matter what work is contracted by the applicant. This requirement of 10 CFR 50 is intended to insure proper application of the quality assurance program by vesting in one organization those decisions to be made in applying quality assurance criteria. The decisions made by the applicant are reviewed by the NRC.
- Technical Significance in Terms of Safe Operation - The quality assurance program must be directed toward an object such as a component or system or service. The degree to which quality assurance activities are applied depends on the object's technical significance in terms of safe operation. In other words, how essential is the component, system, or service to safe operation? All quality assurance decisions within the latitude of regulations, codes, standards, and specifications are made based on the answer to this question.

#### Development of the QA Program by the Owner

Each applicant for a Construction Permit for a nuclear power plant or nuclear fuel processing facility is required by 10 CFR 50 to include in its Preliminary Safety Analysis Report (PSAR) a description of the QA Program that will be applied to the design, fabrication, construction, and testing of the structures, systems and components of the facility. Every applicant for an Operating License is further required by 10 CFR 50 to include in its Final Safety Analysis Report (FSAR) information pertaining to the managerial and administrative controls to be used to assure safe operation.

These areas of both the PSAR and the FSAR must cover the application of the eighteen criteria of the Quality Assurance Program given by 10 CFR 50, Appendix B. Such application of 10 CFR 50, Appendix B, is directed toward structures, systems, and components that prevent or mitigate the consequences of postulated accidents that could cause undue risk to the public. In this regard, the requirements apply to all activities affecting the safety-related functions of such systems, structures, and components. These activities include:

- |               |               |
|---------------|---------------|
| - Designing   | - Installing  |
| - Purchasing  | - Inspecting  |
| - Fabricating | - Testing     |
| - Handling    | - Operating   |
| - Shipping    | - Maintaining |
| - Receiving   | - Repairing   |
| - Storing     | - Refueling   |
| - Cleaning    | - Modifying   |
| - Erecting    |               |

#### Phase of Activities

The activities associated with a nuclear power plant logically fall within one of three phases: design, construction and operation. Each of these phases are discussed.

The Design Phase is that phase which produces drawings and specifications for use in procurement of items, construction of facilities and installation of components, and operation of the plant. It sets forth the design of plant systems, structures, and components. A quality assurance program must be established and functional at the outset of the design phase. The QA program confirms the adequacy of the design and insures that required quality assurance criteria are included in specifications and procurement documents.



The Construction Phase is that phase which prepares the site and erects the plant such that the operations phase may commence. It commences with either excavations or receipt of components at the construction site and ends when the components and systems are ready for turnover to operations personnel for startup testing. During the construction phase the Quality Assurance Program applies to all construction activities including receipt, storage, handling, installation, inspection, and test. The QA Program for the design and construction phases must be described in the Preliminary Safety Analysis Report that is a prerequisite for a construction permit.

The Operation Phase is that phase which tests the operability of the plant and subsequently operates the plant. It begins with either preoperational testing or fuel receipt. This phase includes preoperational and start-up testing, normal operations, response to emergencies, surveillance testing, maintenance, chemistry control, radiation protection, radioactive waste control, fire protection, respiratory protection, safety, environmental monitoring, modification control, records and reports management, training, material control and security. All of these operations phase activities are governed by written procedures and are subject to Quality Assurance audits. The Operations Phase Quality Assurance Program must be described in the Final Safety Analysis Report at the time of application for an operating license.

#### Eighteen Criteria

Eighteen quality assurance criteria are set forth in 10 CFR 50 Appendix B to establish the quality assurance requirements for the design, construction and operation phases of nuclear power stations. The copy of 10 CFR 50 Appendix B, that is reprinted at the end of this module

should be read in conjunction with the following overview of the criteria:

- Organization - This criterion requires clearly defined responsibilities for both the doer and the checker. It also requires that the checker have sufficient authority to identify quality problems and cause them to be fixed. This insures that cost and schedule doesn't overrule quality requirements.

There are many ways of organizing a quality assurance organization. However, to comply with the requirements of 10 CFR 50, Appendix B, it is necessary that persons or organizations performing QA functions report to a management level whose sole concern is not limited to cost and schedule. As illustrated in Figure 31-1-1, QA typically reports to senior management officials at a level high enough to ensure the separation of responsibility between QA and other departments. This separation is considered necessary to insure objectivity and sufficient freedom from schedules and cost pressures to reduce the risk of compromising safety.

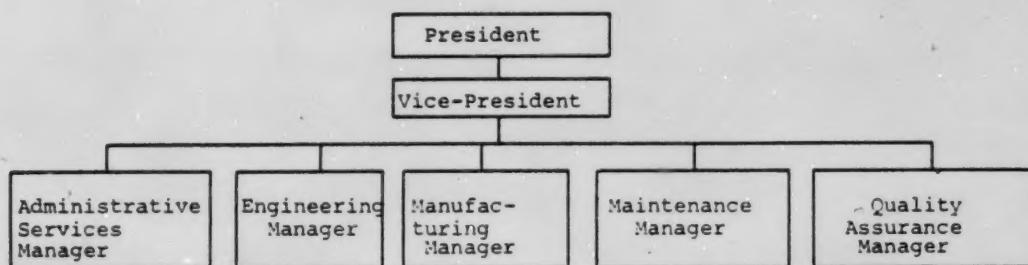


Figure 31-1-1. Example Organization

The QA/QC Technician may be an audit team member responsible for determining that a contractor's

organization meets this criterion.

- Quality Assurance Program - This criterion requires written documents that delineate the scope of the quality assurance program and provide instructions for carrying it out. It also requires training of personnel and insuring that necessary skills are used in each area of the program. It is intended to insure that all portions of the program are pre-planned and properly managed rather than leaving matters to chance.

Qualification of quality assurance and quality control personnel is based on experience and training. The personnel qualification requirements for non-destructive examination are described in SNT-TC-1A that is published by the American Society for Non-destructive Testing. Qualification of other QA/QC Technicians is governed by ANSI N45.2.6. Both SNT-TC-1A and ANSI N45.2.6 describe three levels of qualification. Level I qualification is the lowest level; it applies to the individual who implements inspection and test procedures. Level II qualification is the next higher level; it applies to the person who evaluates and reports on results of inspections and tests. Level III qualification is the highest level; it applies to the person who approves inspection and test procedures. Module 31.6 of this course describes fully these qualification programs.

The QA/QC Technician must qualify to Level I and/or Level II for many of the technician's tasks. Also, the QA/QC Technician may participate in audits which determine that other inspection and test personnel are properly qualified.

- Design Control - In theory, a properly designed component that is built exactly to design will perform

in service without problems. This criterion pushes practice toward the theoretical objective. It requires checks, reviews, independent analyses and tests to assure that the designer's specifications and drawings are complete, accurate, and technically satisfactory. The independent reviews, checks, analyses and tests for design control are normally performed by personnel with design engineering expertise. The QA/QC Technician can be an audit team member responsible for confirming that planned control measures have been taken.

- Procurement Document Control - It is axiomatic that the purchaser receives no more than what is ordered. This criterion requires that purchase orders be complete and accurate. It also requires placing responsibility on contractors for including in their purchase orders with subcontractors complete and accurate ordering data. The QA/QC Technician reviews procurement documents to ensure inclusion of appropriate quality assurance requirements whether for materials or services.
- Instructions, Procedures and Drawings - This criterion requires that the activities of doers and checkers be described in instructions, procedures, and/or drawings and that such documents clearly specify acceptance criteria. Activities carried out by the QA/QC Technician are described in procedures and instructions. Also, the QA/QC Technician may be responsible for preparing certain procedures and instructions and for reviewing other procedures and instructions for compliance with governing regulations, codes and standards.
- Document Control - This criterion requires that documents be reviewed prior to their use and that revisions to the documents receive a similar review.



It also requires that the correct document and revision thereof be distributed to and used by the doer and checker. The QA/QC Technician may be responsible for monitoring this system to confirm that documents are being controlled consistent with this criterion.

- Control of Purchased Material, Equipment and Services - This criterion requires that the procuring organization take one or more actions to assure that what is delivered is identical to what is ordered. Assurance actions include qualification of vendors based on audits and knowledge of prior performance, inspection at the vendor's plant and/or at receipt of the ordered items, and documented evidence of compliance supplied by the vendor. The QA/QC Technician may perform a variety of tasks related to this criterion. Inspections may be performed at the supplier's plant or at receipt of the ordered items. The supplier's certifications may be reviewed for conformance with governing procurement documents. Audits may be performed at the supplier's plant. The supplier's quality assurance manual may be reviewed for compliance with the quality assurance requirements specified by the contract.
- Identification and Control of Materials, Parts, and Components - The design of nuclear components often requires use of only certain alloys of specific material condition. To guard against the inadvertent substitution of material types and conditions, this criterion requires the identity of materials to be maintained at all times. Each inspection and monitoring activity performed by QA/QC Technicians involves checks for identity of materials, parts and components. Constant vigilance is needed to insure that properly identified items are handled at all times



in a manner that maintains (i.e. does not lose or destroy) identity of the item.

- Control of Special Processes - Special processes such as welding and heat treating directly affect the material properties of components and parts. Therefore, control of the process is needed to insure that the desired material properties are obtained. Similarly, nondestructive examination is controlled because the examination results are affected by the step-by-step sequence of the examination. This criterion requires control by requiring that special processes be performed in accordance with written qualified procedures by qualified personnel. QA/QC Technicians have a large role in inspecting and monitoring special processes. Courses 26 and 32 of the Nuclear QA/QC Technician curriculum address this role.
- Inspection - This criterion establishes a specific type of checker, i.e. an inspector. The inspector cannot be the doer. Provisions are made for hold points if subsequent work would alter conditions such that the desired inspection could no longer be made. QA/QC Technicians perform a variety of inspections. The Nuclear QA/QC Technician curriculum includes for this reason the courses 27-Metrology, 28-Weld Inspection, 29-Civil Inspection and 30-Mechanical Inspection.
- Test Control - Similar to criterion 9, this criterion requires written procedures for tests because the test results are affected by the step-by-step sequence of conducting a test. This criterion also insures that components and systems are tested for proper operability prior to being placed in service and periodically thereafter. The QA/QC Technician monitors

the conduct of tests to verify that specific controls are met.

- Control of Measuring and Test Equipment - this criterion requires a system that places measuring and test equipment into the user's hands that are sufficiently accurate for the intended use. Use of "activities affecting quality" in this criterion generally means those measurement and test results which confirm acceptability to a preestablished limit. Measuring and test equipment used only for information do not normally need to be calibrated. The QA/QC Technician is frequently the user of measuring and test equipment and therefore, needs to recognize the limitations of the equipment in terms of accuracy. Also, the QA/QC Technician frequently monitors the calibration system to assure compliance with this criterion.
- Handling, Storage and Shipping - This criterion is intended to maintain the quality of an item during the time interval between its manufacture and its installation. The QA/QC Technician performs a variety of inspections and checks to confirm compliance with this criterion.
- Inspection, Test and Operating Status - The key word is "status". By visually observing an item, component or part, one should be able to determine from marking, tagging, stamping or other means that it has been inspected or tested or released for operation. Failure of the item, component or part to physically bear such evidence is assumed to mean that the inspection or test has not yet occurred. However, when items are taken out of service, they are normally tagged to indicate a "do not operate" status. The QA/QC Technician applies the marking, tags or stamp-

ing to represent inspections he or she performs. For those inspections and tests performed by others, the QA/QC Technician monitors for compliance with this criterion.

- Nonconforming Materials, Parts, or Components - Nonconforming items are physically tagged (or otherwise marked) to indicate their rejected status. The identification method is distinctively different than the method used for criterion 14, e.g., a red tag may be used for a nonconforming item while a green tag may be used for an accepted item. If possible, nonconforming items are physically segregated from accepted items. The QA/QC Technician applies the tag (or other marking) to indicate rejected status. Also, the QA/QC Technician monitors the handling, storage and repair of nonconforming items to verify that rejected status marking is maintained until repairs are made and accepted.
- Corrective Action - This criterion requires correction of any problem. Where significant conditions adverse to quality are observed, the cause of such conditions is determined and eliminated. The "doer" normally determines and implements corrective action. The QA/QC Technician identifies the need for corrective action and verifies that effective corrective action has been taken where needed.
- Quality Assurance Records - Millions of pages of records are generated by design, construction and operation of a nuclear power plant. This criterion requires that the Quality Assurance Program define those records to be maintained, their retention period and a method for their recall from storage. Frequently, computer aided records storage and retrieval systems are used. The QA/QC Technician

reviews and monitors records prepared by others to assure completeness, accuracy and legibility and verifies that the records are properly maintained.

- Audits - The audits have two purposes. First, they determine compliance with the documented Quality Assurance Program. Secondly, they measure the effectiveness of the Quality Assurance Program. The latter purpose is more difficult to achieve because it requires professional judgement in many cases. The QA/QC Technician participates as an audit team member in quality assurance audits.

### Pyramids of Vendors

The owner of a single nuclear power station is faced with applying the eighteen criteria of 10 CFR 50, Appendix B to several hundred vendors. The legal channel, i.e., the contract channel, is used for this purpose. This overall contracting channel is illustrated in Figure 31-1-2.

As shown in Figure 31-1-2, the first level of contractors below the nuclear utility are those involved with design. There are three major areas of design: the Nuclear Steam Supply System, the remainder of the station's systems and the buildings and structures that house all the systems. There are only five contractors for the Nuclear Steam Supply System: Babcock and Wilcox Company, Combustion Engineering, Inc., General Atomic Corporation, General Electric Company, and Westinghouse Electric Company. The owner contracts with one of these contractors for the reactor and associated reactor systems. There are many architect-engineering firms that offer design services for the remainder of the station's systems and the buildings and structures. Also, many utilities have their own design groups for these areas.

The prime construction contractor may be the nuclear utility or a construction firm contracted by the nuclear utility. The prime construction contractor typically



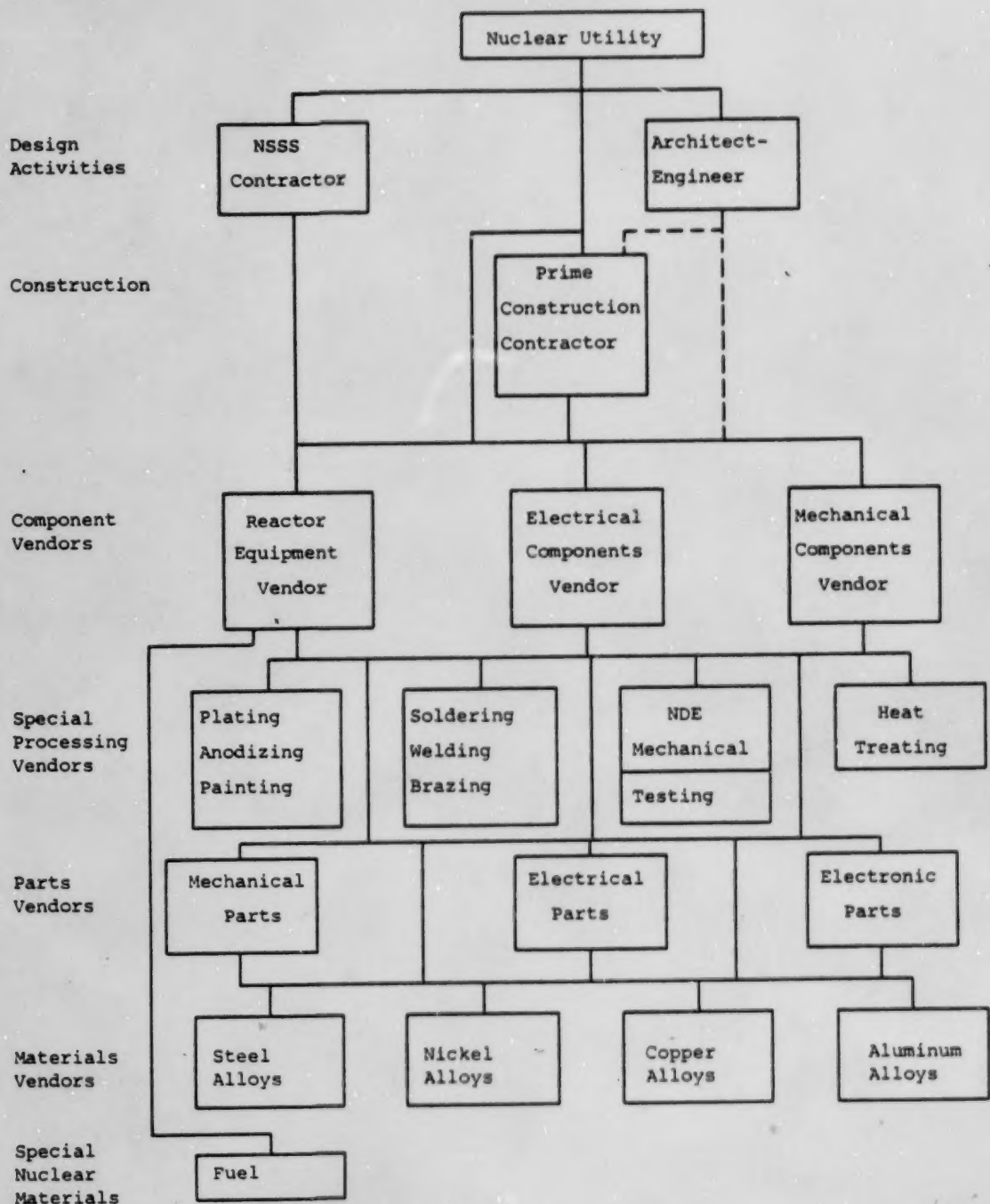


Figure 31-1-2. Pyramid of Vendors

subcontracts to obtain the diverse skills needed to construct a nuclear power station.

The next tier of vendors is the component suppliers. Contracts may be placed with this tier by the nuclear utility, the architect-engineer, and the NSSS supplier. This tier of vendors delivers pressure vessels, pumps, valves, motors, turbines, generators, switchgear, piping, etc. Delivery is normally to the construction site where components are stored until the construction contractor is ready to install them.

The next tier of vendors is the parts suppliers. Procurement with parts suppliers may be for standardized parts that are commercially available or for specialized parts requiring processing not available within the purchaser's resources. Parts suppliers may receive purchase orders from any of the higher-tier contractors.

The next tier of vendors includes the specialty shops. These are vendors that offer specialized processing that may not be economically feasible for the construction, component or parts vendors. This category includes welding, brazing, heat treating, non-destructive and destructive examination, plating, anodizing, painting and highly specialized machining such as electro-discharge machining. The nuclear utility, NSSS supplier, prime construction contractor, component supplier and parts vendor could have orders with this category of vendors.

The final tier of vendors includes the material suppliers. Depending on the material condition being purchased, this tier includes melters and metal finishers. Any of the other tiers of vendors may have direct orders with the material suppliers.

#### Contracts, Subcontracts, Orders, Purchase Orders

Various terms are applied to the legal document that

binds an agreement between the purchaser and the supplier. This legal document may be termed contract, subcontract, order, or purchase order. Nonetheless, these terms are synonymous from a legal viewpoint and are used interchangeably in this module.

A contract binds both the buyer and the supplier. In its most simple form, this means that the buyer must pay the supplier the agreed upon price upon delivery of the purchased item or service and the supplier must deliver the purchased item or service as required by the contract. In reality, many more conditions of agreement are described by the contract pertaining to both the buyer's and the supplier's obligations. Quality Assurance requirements are applied as a portion of these agreements.

The nuclear utility, being at the head of the pyramid of vendors, places contracts for those items to which the nuclear QA program applies that contain three types of quality assurance requirements. First, QA requirements are specified which apply to the work performed by the contractor. Secondly, QA requirements are specified which instruct the contractor to place in subcontracts with other vendors QA requirements appropriate to the item or service ordered. Thirdly, QA requirements are specified which require the contractor to require their contractors to place appropriate QA requirements in any further contracting of work. These latter two types of requirements insure that appropriate QA requirements are passed on within contracts no matter how far down the pyramid of vendors contracts are placed. Criterion VII of Appendix B to 10 CFR 50 requires such passing down of appropriate QA requirements.

#### Application of Quality Assurance Criteria

As previously described, quality assurance criteria are applied to the applicant for license of a nuclear power plant by the U.S. Code of Federal Regulations and the appli-

cant must apply appropriate quality assurance requirements to all tiers of contractors. Determination of what is appropriate is a complex process. The decision is not normally made by a single individual unless very specific guidelines have been previously agreed upon by all concerned parties.

American National Standards, ANSI N45.2, Quality Assurance Program Requirements for Nuclear Power Plants for Design and Construction and ANSI N18.7, Administrative Controls and Quality Assurance for the Operational Phase of Nuclear Power Plants give similar guidance for applying quality assurance requirements to contractors. This guidance states that procurement documents shall include provisions for identification of quality assurance requirements applicable to the items or services procured. This may be accomplished in various ways, such as (1) invoking ANSI N45.2, (2) invoking applicable sections of ANSI N45.2 or ANSI N18.7, or (3) invoking specific requirements that meet the intent of portions of ANSI N45.2 or ANSI N18.7.

The key is the phrase "applicable to the items or services procured". The technical significance of the item or service is judged in terms of its role in the safe and reliable operation of the nuclear power plant. Items and services that are essential to safe operation receive more stringent quality assurance requirements than those that are nonessential to safe operation.

The ASME Boiler and Pressure Vessel Code (Code) governs manufacture and installation of components which pressure boundaries. This Code includes in Section III, Subsection NA, Article NA-4000 criteria for quality assurance programs for contractors who fabricate or install Code components. Code quality assurance criteria are essentially the same as those of ANSI N45.2 but they apply only to the work which is governed by the Code. Therefore, the Code quality assurance requirements are typically



sufficient for a fabricator of a Code component. But for the installer, additional criteria are imposed by the system design specification which typically requires application of quality assurance requirements of both the Code and ANSI N45.2.

Utilities often use a "Q" list to assist in the designation of quality assurance requirements. The Q list identifies those components and systems which require application of quality assurance requirements in order to meet the licensing commitments to the NRC.

The extent of application of quality assurance requirements by contract may be affected by the extent of quality assurance activities of the purchaser. That is, the purchaser may elect to perform quality verification activities and not require the contractor to perform all quality verification. In this regard, the purchaser may consider such activities as (1) performing inspections and tests at the contractor's plant, (2) performing inspections and tests of components upon receipt, and (3) inspecting and testing the work of the construction contractor.

#### Standardization of QA Requirements

The criteria of Appendix B to 10 CFR 50 and the requirements of ANSI N45.2, ANSI N18.7, and the ASME Boiler and Pressure Vessel Code give latitude in the methods of meeting the criteria and requirements. While such latitude is desirable to permit application of quality assurance requirements commensurate with the significance of the item or service, it can be undesirable from a competitor's view point. If one company is forced to use elaborate methods while a competitor to that company is permitted to use skimpy methods, an undesirable imbalance results. Some degree of standardization of methods is therefore desirable provided that sufficient latitude is retained to

permit acceptance of two or more equally effective methods of meeting the same requirement.

An additional degree of standardization of methods of implementing QA criteria is provided by a series of standards that are required to be used to supplement ANSI N45.2 for the design and construction phases and ANSI N18.7 for the operations phase. These standards are:

- ANSI N45.2.1 - Cleaning of Fluid Systems and Associated Components During the Construction Phase of Nuclear Power Plants
- ANSI N45.2.2 - Packaging, Shipping, Receiving, Storage and Handling of Items for Nuclear Power Plants (During the Construction Phase)
- ANSI N45.2.3 - Housekeeping During the Construction Phase of Nuclear Power Plants
- ANSI N45.2.4 - Installation, Inspection and Testing Requirements for Instrumentation and Electric Equipment During the Construction of Nuclear Power Generating Stations
- ANSI N45.2.5 - Supplementary Quality Assurance Requirements for Installation, Inspection, and Testing of Structural Concrete and Structural Steel During the Construction Phase of Nuclear Power Plants
- ANSI N45.2.6 - Qualifications of Inspection, Examination and Testing Personnel for the Construction Phase of Nuclear Power Plants
- ANSI N45.2.8 - Supplementary Quality Assurance Requirements for Installation, Inspection and Testing of Mechanical Equipment and Systems for the Construction Phase of Nuclear Power Plants
- ANSI N45.2.9 - Requirements for Collection, Storage, and Maintenance of Quality Assurance Records for Nuclear Power Plants
- ANSI N45.2.10 - Quality Assurance Terms and Definitions

- ANSI N45.2.11 - Quality Assurance Requirements for the Design of Nuclear Power Plants
- ANSI N45.2.12 - Requirements for Auditing of Quality Assurance Programs for Nuclear Power Plants
- ANSI N45.2.13 - Quality Assurance Requirements for Control of Procurement of Items and Services for Nuclear Power Plants
- ANSI N45.2.14 - Design and Quality Assurance Requirements During the Design and Manufacture of Class IE Instrumentation and Electric Equipment for Nuclear Power Generating Stations
- ANSI N45.2.15 - Requirements for the Control of Hoisting, Rigging, and Transporting of Items at Nuclear Power Plant Sites
- ANSI N45.2.16 - Supplementary Requirements for the Calibration and Control of Measuring and Test Equipment Used in the Construction and Maintenance of Nuclear Facilities
- ANSI N45.2.18 - Supplementary Quality Assurance Requirements for Installation, Inspection and Testing of Precast, Prestressed, Preplaced and Heavy Aggregate Concrete During the Construction of Nuclear Power Plants
- ANSI N45.2.19 - Supplementary Quality Assurance Requirements Related to Soil and Foundations During the Construction Phase of Nuclear Power Plants
- ANSI N45.2.20 - Supplementary Quality Assurance Requirements for Sub-Surface Investigations Prior to the Construction Phase of Nuclear Power Plants
- ANSI N45.2.21 - Quality Assurance Program Requirements for Nuclear Power Plant Fuels
- ANSI N45.2.22 - Supplementary Requirements for Inspection of Dimensional Characteristics
- ANSI N45.2.23 - Qualification of Quality Assurance

## Program Audit Personnel for Nuclear Facilities

### Relationship of QA and Technical Requirements

The term technical requirements refers to the contents of codes, standards, specifications and drawings which prescribe the features and characteristics to be inherent in the item or service. Technical requirements may also govern the type and nature of processing activities incumbent in producing, inspecting, and testing the item or service. Each contract specifies the technical requirements and the quality assurance requirements to be met.

Review of the eighteen criteria of Appendix B to 10 CFR 50 quickly points out that technical requirements are stated, referenced or implied in every criterion. It is the technical requirements, which include product acceptance criteria, that establish the inherent quality to be expected. If technical requirements change, the product or processing of the product must also change to be consistent with the revised technical requirements. Adding or deleting ANSI N45.2 or any of the supplementary QA standards does not change the inherent quality required by the technical requirements. The purpose of the QA specifications is to require managerial and administrative controls which more positively assure that required inherent quality is in fact achieved. Therefore, the effectiveness of any QA program is best measured in terms of its ability to ensure (1) establishment of technical requirements consistent with design criteria and (2) compliance with established technical requirements by all concerned organizations.

For illustration of the relationship between technical and QA requirements, Criterion VI of 10 CFR 50 Appendix B, requires measures for controlling the issuance of documents. One of the measures is review of documents for adequacy. The question is "what is adequate?" ANSI N45.2 states that



reviewers of documents "shall have access to pertinent background information upon which to base (their) approval and shall have an adequate understanding of the requirements and intent of the original document". Therefore, adequacy is considered in terms of technical criteria. If the document is design document, adequacy involves the technical bases by which the contents of the document were derived and are supported. If it is a manufacturing document, adequacy involves the completeness and accuracy of its contents in translating the design criteria into manufacturing instructions. Adequacy of any document can similarly be traced, directly or indirectly, to some governing technical requirement.

In continuing this illustration, document control measures must also include provisions for distributing documents to the user. Again the concern is with assuring that document control is proceeding in a technically satisfactory manner. The concern is with users of the document. If the document is also distributed to non-users, the criterion no longer applies.

# APPENDIX B-QUALITY ASSURANCE CRITERIA FOR NUCLEAR POWER PLANTS AND FUEL REPROCESSING PLANTS

**Introduction.** Every applicant for a construction permit is required by the provisions of § 50.34 to include in its preliminary safety analysis report a description of the quality assurance program to be applied to the design, fabrication, construction, and testing of the structures, systems, and components of the facility. Every applicant for an operating license is required to include, in its final safety analysis report, information pertaining to the managerial and administrative controls to be used to assure safe operation. Nuclear powerplants and fuel reprocessing plants\* include structures, systems, and components that prevent or mitigate the consequences of postulated accidents that could cause undue risk to the health and safety of the public. This appendix establishes quality assurance requirements for the design, construction, and operation of those structures, systems, and components. The pertinent requirements of this appendix apply to all activities affecting the safety-related functions of those structures, systems, and components; these activities include designing, purchasing, fabricating, handling, shipping, storing, cleaning, erecting, installing, inspecting, testing, operating, maintaining, repairing, refueling, and modifying.

As used in this appendix, "quality assurance" comprises all those planned and systematic actions necessary to provide adequate confidence that a structure, system, or component will perform satisfactorily in service. Quality assurance includes quality control, which comprises those quality assurance actions related to the physical characteristics of a material, structure, component, or system which provide a means to control the quality of the material, structure, component, or system to predetermined requirements.

## I. ORGANIZATION

The applicant shall be responsible for the establishment and execution of the quality assurance program. The applicant may delegate to others, such as contractors, agents, or consultants, the work of establishing and executing the quality assurance program, or any part thereof, but shall retain responsibility therefor. The authority and duties of persons and organizations performing activities affecting the safety-related functions of structures, systems, and components shall be clearly established and delineated in writing. These activities include both the performing functions of attaining quality objectives and the quality assurance functions. The quality assurance functions are those of (a) assuring that an appropriate quality assurance program is established and effectively executed and (b) verifying, such as by checking, auditing, and inspection, that activities affecting the safety-related functions have been correctly performed. The persons and organizations performing quality assurance functions shall have sufficient authority and organizational freedom to identify quality problems; to initiate, recommend, or provide solutions; and to verify implementation of solutions. Such persons and organizations performing quality assurance functions shall report to a management level such that this required authority and organizational freedom, including sufficient independence from cost and schedule when opposed to safety considerations, are provided. Because of the

many variables involved, such as the number of personnel, the type of activity being performed, and the location or locations where activities are performed, the organizational structure for executing the quality assurance program may take various forms provided that the persons and organizations assigned the quality assurance functions have this required authority and organizational freedom. Irrespective of the organizational structure, the individual(s) assigned the responsibility for assuring effective execution of any portion of the quality assurance program at any location where activities subject to this Appendix are being performed shall have direct access to such levels of management as may be necessary to perform this function.

## II. QUALITY ASSURANCE PROGRAM

The applicant shall establish at the earliest practicable time, consistent with the schedule for accomplishing the activities, a quality assurance program which complies with the requirements of this appendix. This program shall be documented by written policies, procedures, or instructions and shall be carried out throughout plant life in accordance with those policies, procedures, or instructions. The applicant shall identify the structures, systems, and components to be covered by the quality assurance program and the major organizations participating in the program, together with the designated functions of these organizations. The quality assurance program shall provide control over activities affecting the quality of the identified structures, systems, and components, to an extent consistent with their importance to safety. Activities affecting quality shall be accomplished under suitably controlled conditions. Controlled conditions include the use of appropriate equipment; suitable environmental conditions for accomplishing the activity, such as adequate cleanliness; and assurance that all prerequisites for the given activity have been satisfied. The program shall take into account the need for special controls, processes, test equipment, tools, and skills to attain the required quality, and the need for verification of quality by inspection and test. The program shall provide for indoctrination and training of personnel performing activities affecting quality as necessary to assure that suitable proficiency is achieved and maintained. The applicant shall regularly review the status and adequacy of the quality assurance program. Management of other organizations participating in the quality assurance program shall regularly review the status and adequacy of that part of the quality assurance program which they are executing.

\* While the term "applicant" is used in these criteria, the requirements are, of course, applicable after such a person has received a license to construct and operate a nuclear power plant or a fuel reprocessing plant. These criteria will also be used for guidance in evaluating the adequacy of quality assurance programs in use by holders of construction permits and operating licenses.

\* Amended 36 FR 18301.

### III. DESIGN CONTROL

Measures shall be established to assure that applicable regulatory requirements and the design basis, as defined in § 50.2 and as specified in the license application, for those structures, systems, and components to which this appendix applies are correctly translated into specifications, drawings, procedures, and instructions. These measures shall include provisions to assure that appropriate quality standards are specified and included in design documents and that deviations from such standards are controlled. Measures shall also be established for the selection and review for suitability of application of materials, parts, equipment, and processes that are essential to the safety-related functions of the structures, systems and components.

Measures shall be established for the identification and control of design interfaces and for coordination among participating design organizations. These measures shall include the establishment of procedures among participating design organizations for review, approval, release, distribution, and control of documents involving design

The design control measures shall provide for verifying or checking the adequacy of design, such as by the performance of design reviews, by the use of alternate or simplified calculational methods, or by the performance of a suitable testing program. The verifying or checking process shall be performed by individuals or groups other than those who performed the original design, but who may be from the same organization. Where a test program is used to verify the adequacy of a specific design feature in lieu of other verifying or checking processes, it shall include suitable qualification testing of a prototype unit under the most adverse design conditions. Design control measures shall be applied to items such as the following: reactor physics, stress, thermal, hydraulic, and accident analyses; compatibility of materials; accessibility for inservice inspection, maintenance, and repair; and delineation of acceptance criteria for inspections and tests.

Design changes, including field changes, shall be subject to design control measures commensurate with those applied to the original design and be approved by the organization that performed the original design unless the applicant designates another responsible organization.

### IV. PROCUREMENT DOCUMENT CONTROL

Measures shall be established to assure that applicable regulatory requirements, design bases, and other requirements which are necessary to assure adequate quality are suitably included or referenced in the documents for procurement of material, equipment, and services, whether purchased by the applicant or by its contractors or subcontractors. To the extent necessary, procurement documents shall require contractors or subcontractors to provide a quality assurance program consistent with the pertinent provisions of this appendix.

### V. INSTRUCTIONS, PROCEDURES, AND DRAWINGS

Activities affecting quality shall be prescribed by documented instructions, procedures, or drawings, or a type appropriate to the circumstances and shall be accomplished in accordance with these instructions, procedures, or drawings. Instructions, procedures, or drawings shall include appropriate

quantitative or qualitative acceptance criteria for determining that important activities have been satisfactorily accomplished.

### VI. DOCUMENT CONTROL

Measures shall be established to control the issuance of documents, such as instructions, procedures, and drawings, including changes thereto, which prescribe all activities affecting quality. These measures shall assure that documents, including changes, are reviewed for adequacy and approved for release by authorized personnel and are distributed to and used at the location where the prescribed activity is performed. Changes to documents shall be reviewed and approved by the same organizations that performed the original review and approval unless the applicant designates another responsible organization.

### VII. CONTROL OF PURCHASED MATERIAL, EQUIPMENT, AND SERVICES

Measures shall be established to assure that purchased material, equipment, and services, whether purchased directly or through contractors and subcontractors, conform to the procurement documents. These measures shall include provisions, as appropriate, for source evaluation and selection, objective evidence of quality furnished by the contractor or subcontractor, inspection at the contractor or subcontractor source, and examination of products upon delivery. Documentary evidence that material and equipment conform to the procurement requirements shall be available at the nuclear powerplant or fuel reprocessing plant site prior to installation or use.

Such material and equipment. This documentary evidence shall be retained at the nuclear powerplant or fuel reprocessing plant site and shall be sufficient to identify the specific requirements, such as codes, standards, or specifications, met by the purchased material and equipment. The effectiveness of the control of quality by contractors and subcontractors shall be assessed by the applicant or designee at intervals consistent with the importance, complexity, and quantity of the product or services.

### VIII. IDENTIFICATION AND CONTROL OF MATERIALS, PARTS, AND COMPONENTS

Measures shall be established for the identification and control of materials, parts, and components, including partially fabricated assemblies. These measures shall assure that identification of the item is maintained by heat number, part number, serial number, or other appropriate means, either on the item or on records traceable to the item, as required throughout fabrication, erection, installation, and use of the item. These identification and control measures shall be designed to prevent the use of incorrect or defective material, parts, and components.

### IX. CONTROL OF SPECIAL PROCESSES

Measures shall be established to assure that special processes, including welding, heat treating, and nondestructive testing, are controlled and accomplished by qualified personnel using qualified procedures in accordance with applicable codes, standards, specifications, criteria, and other special requirements.

### X. INSPECTION

A program for inspection of activities affecting quality shall be established and

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executed by or for the organization performing the activity to verify conformance with the documented instructions, procedures, and drawings for accomplishing the activity. Such inspection shall be performed by individuals other than those who performed the activity being inspected. Examinations, measurements, or tests of material or products processed shall be performed for each work operation where necessary to assure quality. If inspection of processed material or products is impossible or disadvantageous, indirect control by monitoring processing methods, equipment, and personnel shall be provided. Both inspection and process monitoring shall be provided when control is inadequate without both. If mandatory inspection hold points, which require witnessing or inspecting by the applicant's designated representative and beyond which work shall not proceed without the consent of its designated representative are required, the specific hold points shall be indicated in appropriate documents.

#### XII. TEST CONTROL

A test program shall be established to assure that all testing required to demonstrate that structures, systems, and components will perform satisfactorily in service is identified and performed in accordance with written test procedures which incorporate the requirements and acceptance limits contained in applicable design documents. The test program shall include, as appropriate, proof tests prior to installation, preoperational tests, and operational tests during nuclear powerplant or fuel reprocessing plant operation, of structures, systems, and components. Test procedures shall include provisions for assuring that all prerequisites for the given test have been met, that adequate test instrumentation is available and used, and that the test is performed under suitable environmental conditions. Test results shall be documented and evaluated to assure that test requirements have been satisfied.

#### XII. CONTROL OF MEASURING AND TEST EQUIPMENT

Measures shall be established to assure that tools, gages, instruments, and other measuring and testing devices used in activities affecting quality are properly controlled, calibrated, and adjusted at specified periods to maintain accuracy within necessary limits.

#### XIII. HANDLING, STORAGE, AND SHIPPING

Measures shall be established to control the handling, storage, shipping, cleaning, and preservation of material and equipment in accordance with work and inspection instructions to prevent damage or deterioration. When necessary for particular products, special protective environments, such as inert gas atmosphere, specific moisture content levels, and temperature levels, shall be specified and provided.

#### XIV. INSPECTION, TEST, AND OPERATING STATUS

Measures shall be established to indicate, by the use of markings such as stamps, tags, labels, routing cards, or other suitable means, the status of inspections and tests performed upon individual items of the nuclear powerplant or fuel reprocessing plant. These measures shall provide for the

identification of items which have satisfactorily passed required inspections and tests, where necessary to preclude inadvertent bypassing of such inspections and tests. Measures shall also be established for indicating the operating status of structures, systems, and components of the nuclear powerplant or fuel reprocessing plant, such as by tagging valves and switches, to prevent inadvertent operation.

#### XV. NONCONFORMING MATERIALS, PARTS, OR COMPONENTS

Measures shall be established to control materials, parts, or components which do not conform to requirements in order to prevent their inadvertent use or installation. These measures shall include, as appropriate, procedures for identification, documentation, segregation, disposition, and notification to affected organizations. Nonconforming items shall be reviewed and accepted, rejected, repaired, or reworked in accordance with documented procedures.

#### XVI. CORRECTIVE ACTION

Measures shall be established to assure that conditions adverse to quality, such as failures, malfunctions, deficiencies, deviations, defective material and equipment, and nonconformances are promptly identified and corrected. In the case of significant conditions adverse to quality, the measures shall assure that the cause of the condition is determined and corrective action taken to preclude repetition. The identification of the significant condition adverse to quality, the cause of the condition, and the corrective action taken shall be documented and reported to appropriate levels of management.

#### XVII. QUALITY ASSURANCE RECORDS

Sufficient records shall be maintained to furnish evidence of activities affecting quality. The records shall include at least the following: Operating logs and the results of reviews, inspections, tests, audits, monitoring of work performance, and materials analyses. The records shall also include closely-related data such as qualifications of personnel, procedures, and equipment. Inspection and test records shall, as a minimum, identify the inspector or data recorder, the type of observation, the results, the acceptability, and the action taken in connection with any deficiencies noted. Records shall be identifiable and retrievable. Consistent with applicable regulatory requirements, the applicant shall establish requirements concerning record retention, such as duration, location, and assigned responsibility.

#### XVIII. AUDITS

A comprehensive system of planned and periodic audits shall be carried out to verify compliance with all aspects of the quality assurance program and to determine the effectiveness of the program. The audits shall be performed in accordance with the written procedures or check lists by appropriately trained personnel not having direct responsibilities in the areas being audited. Audit results shall be documented and reviewed by management having responsibility in the area audited. Followup action, including re-audit of deficient areas, shall be taken where indicated.

\* Amended 36 FR 18,301





## EXERCISES

The following exercises reinforce the information presented in this module:

1. Research the following reference materials and answer the questions based on the contents of the reference materials:
  - NRC Regulatory Guide 1.33, Quality Assurance Program Requirements (Operations)
  - ANSI N45.2, Quality Assurance Program Requirements for Nuclear Power Plants
  - ANSI N18.7, Administrative Controls and Quality Assurance for the Operational Phase of Nuclear Power Plants
  - 10 CFR 50, Appendix B, Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants.
  - What is the relationship of Regulatory Guides 1.28 and 1.33 to 10 CFR 50, Appendix B and ANSI N45.2 and ANSI N18.7?
  - Compare the definitions of "quality assurance" given by 10 CFR 50 Appendix B, ANSI N45.2 and ANSI N18.7. Are the definitions identical? What are the differences, if any?
  - Prepare a matrix that correlates paragraph numbers of ANSI N45.2 and ANSI N18.7 with the eighteen criteria of 10 CFR 50, Appendix B. The following format is suggested:

|            |                      |                      |
|------------|----------------------|----------------------|
| 10 CFR 50  |                      |                      |
| Appendix B | ANSI N45.2           | ANSI N18.7           |
| Criterion  | <u>Paragraph No.</u> | <u>Paragraph No.</u> |
  - Does ANSI N45.2 cover each of the eighteen criteria of 10 CFR 50, Appendix B? If not, give the rationale for each omission.

- Does ANSI N18.7 cover each of the eighteen criteria of 10 CFR 50, Appendix B? If not, give the rationale for each omission.

2. Compare a Quality Assurance Manual of a nuclear company with applicable reference documents and answer the following questions and perform the stated exercises.

(NOTE: The company may be a nuclear utility, construction contractor, NSSS supplier, component supplier or or other type of contractor performing nuclear work. The manual does not have to be the current one in use, i.e., it may be obsolete at the time of use with this activity.)

- Is the scope of the manual defined? Does the scope list the governing reference document? Name the reference documents.
- Compare the organizational structure described by the manual with the requirements of the governing reference document. Describe the degree of independence and authority given to the Quality Assurance organization and state if the degree is in compliance with the reference document.
- Study the section of the manual on procurement and briefly describe the controls employed for (1) qualification of vendors, (2) source inspection, (3) receiving inspection, (4) audits of vendors, (5) procurement document control.
- Study the section of the manual on Personnel Qualification and briefly describe the controls employed for: (1) qualification of nondestructive examination personnel, (2) qualification of dimensional inspectors.
- Study the section of the manual on Document Control and: (1) list each type of document that is controlled, (2) briefly describe how the correct docu-

ment is placed into the user's hands, and (3) briefly describe how a QA/QC Technician at a work station could determine if the correct documents are at the work station.

3. Study the following description of documents and prepare a quality assurance procedure for controlling the documents in accordance with Criterion VI of Appendix B to 10 CFR 50:

- Description of Documents - ABC Company installs components in accordance with a "job package" that is prepared for each installation activity. The job package is comprised of all documents needed for the job. A work order form is used to generate the job package and to schedule the work.

ABC Company's Engineering Department initiates the work order form by assigning a job control number, describing the installation activity in terms of identifying which component is to be installed in which system, naming the installation drawing to be used and stating whether an installation procedure is needed. The work order form then goes to the Engineering Services Department for endorsement. This endorsement acknowledges the work to be done and certifies that an installation procedure will be prepared if Engineering stipulated the need for such a procedure. The work order form then goes to the Central Document Custodian where the job package will be put together. A copy goes to the Installation Coordinator.

Installation drawings are prepared by Engineering services and reviewed by Quality Assurance and approved by Engineering. Each approved drawing is sent to the Central Document Custodian for maintenance of the master approved drawing file.

Installation procedures are prepared by Engineering Services and approved by Quality Assurance. The installation procedures may require the use of other procedures for welding, radiography and quality control inspection. If welding procedures are necessary, Engineering Services prepares the procedures and submits them to Quality Assurance for approval. Quality Assurance prepares radiography procedures and quality control inspection procedures and submits them to Engineering Services for approval. After approval, all these procedures (installation, welding, radiography, and quality control inspection) are sent to the Central Document Custodian for maintenance of the master file of approved procedures.

When the Installation Coordinator is ready to commence the work, the coordinator requests the Central Document Custodian to issue the job package. The Central Document Custodian assembles the job package and submits it to Quality Assurance for review prior to it being released to the Installation Coordinator for use. The Quality Assurance review confirms that the correct drawing, installation procedure, welding procedure, radiographic procedure, and quality control inspection procedure are included.

- Guidance - The document control procedure should address control of approved documents and changes thereto. After preparation of the procedure, check its validity by determining if it would assure that the Quality Assurance review of the job package could determine for each type of document that the correct number and revision is included in the job package.





## MATERIALS

At least one copy of the following materials are required as reference materials to support this module:

1. Title 10, Code of Federal Regulations, Part 50 and Appendix B thereto.
2. Regulatory Guide 1.28, Quality Assurance Program Requirements (Design and Construction)
3. Regulatory Guide 1.33, Quality Assurance Program Requirements (Operation).
4. ANSI N45.2, Quality Assurance Program Requirements for Nuclear Power Plants.
5. ANSI N18.7, Administrative Controls and Quality Assurance for the Operational Phase of Nuclear Power Plants.



## PROCEDURES

Not applicable.



## DATA TABLE

Not applicable.



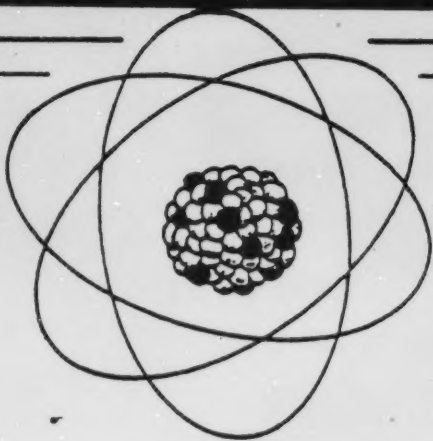
## REFERENCE MATERIALS

- GPO, Code of Federal Regulations, Title 10, Parts 0-199,  
U.S. Government Printing Office, 1978
- NRC, Regulatory Guide 1.28 Quality Assurance Program  
Requirements (Design and Construction), U.S. Nuclear  
Regulatory Commission, 1978
- NRC, Regulatory Guide 1.33, Quality Assurance Program  
Requirements (Operations), U.S. Nuclear Regulatory  
Commission, 1978
- NRC, NUREG-75/087, Standard Review Plan, U.S. Nuclear  
Regulatory Commission, 1978
- ANSI, Quality Assurance Program Requirements for Nuclear  
Facilities, ANSI N45.2, The American Society of  
Mechanical Engineers, 1977
- ANSI, Administrative Controls and Quality Assurance for the  
Operational Phase of Nuclear Power Plants, ANSI N18.7,  
The American Society of Mechanical Engineers, 1976
- ASME, Boiler and Pressure Vessel Code, Section III.  
Subsection NA, General Requirements, The American  
Society of Mechanical Engineers, 1978
- Enrich, Norbert L., Quality Control and Reliability,  
Hitchcock Publishing, 1977
- Juran, J.M., Quality Control Handbook, Hitchcock Publishing,  
1974



# TEST

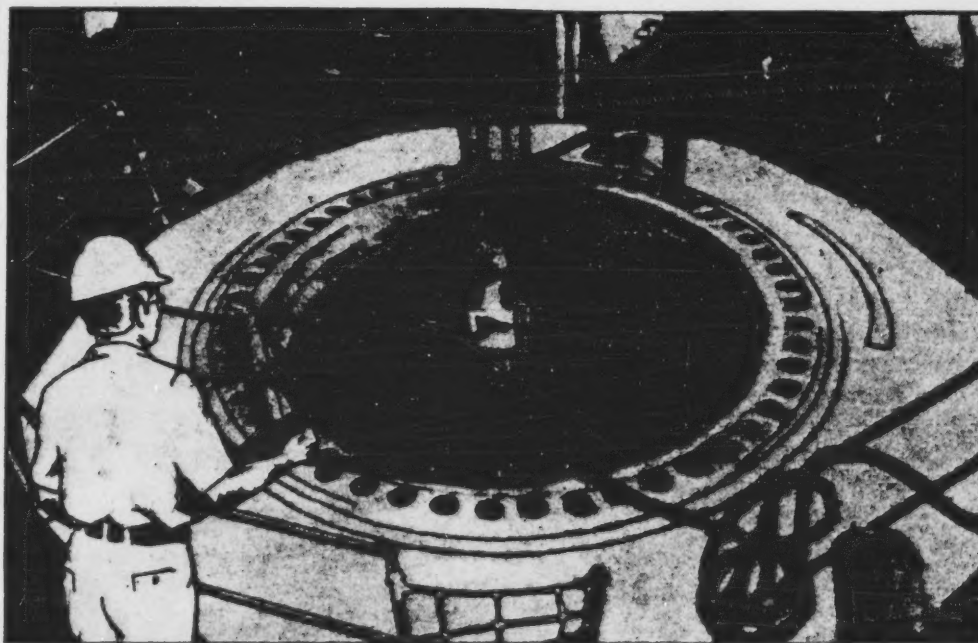
1. Name the regulatory source for quality assurance requirements applicable to nuclear power plants.
2. Name the two principal ANSI standards which provide for the implementation of regulatory requirements.
3. State the purpose of the Design Phase of a QA program.
4. State the purpose of the Construction Phase of a QA program.
5. State the purpose of the Operations Phase of a QA program.
6. What Code of Federal Regulations states the quality assurance requirements for nuclear power plants?
7. What is the purpose of the ANSI N45.2 series of supplementary standards?
8. Define the following terms:
  - a. Design Control
  - b. Procurement Document Control
  - c. Document Control
  - d. Test Control
9. How is the effectiveness of a QA program judged?
10. What is meant by the term "Nonconformance"?
11. What standard gives the quality assurance requirements for the Operations Phase of a nuclear power plant?
12. What are the two elements necessary to be performed by every quality assurance activity?
13. What is meant by the term "safety related"?
14. What are the three major areas of design for a nuclear power plant?
15. What is a "Q" list?
16. Describe what is meant by the term "technical requirements".



# NUCLEAR TECHNOLOGY

## MODULE 31-2

### VENDOR QUALIFICATION



## COURSE 31 QUALITY ASSURANCE PRACTICES



CENTER FOR OCCUPATIONAL RESEARCH AND DEVELOPMENT

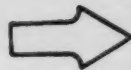
4800 LAKEWOOD DRIVE WACO, TEXAS





## COURSE MODULES

### COURSE 31      QUALITY ASSURANCE PRACTICES



- MODULE 31-1      Overall Quality Assurance Program
- MODULE 31-2      Vendor Qualification
- MODULE 31-3      Receiving Inspection
- MODULE 31-4      Identification, Storage and Handling  
                         of Components, Parts and Materials
- MODULE 31-5      Non-Conforming Materials
- MODULE 31-6      Certification and Qualification of  
                         Quality Control Inspectors
- MODULE 31-7      Auditing for Quality Assurance
- MODULE 31-8      Document Handling, Storage and  
                         Retrieval for Quality Assurance

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## INTRODUCTION

The Nuclear QA/QC Technician performs reviews, inspections, and surveys for the purpose of assisting in the evaluation of suppliers. These tasks may support initial evaluation of suppliers to determine those who are to be considered as "qualified" suppliers. Or, these tasks may support evaluation of the performance of suppliers who have been awarded contracts for items or services. In performing these tasks, the Nuclear QA/QC Technician must be familiar with and apply the procurement policies used by his or her employer.

This module describes the quality assurance requirements for the qualification of suppliers, for evaluating subsequent supplier performance, and for accepting items or services furnished by the supplier. These areas are described by two major divisions: preaward activities and postaward activities.

The module describes the preaward activities of (1) selection of procurement sources and (2) bid evaluation and award. It is the first activity which "qualifies" suppliers. The second activity solicits bids from qualified suppliers and awards the contract to the successful bidder.

The module describes the postaward activities of (1) purchaser evaluation of supplier performance, (2) purchaser verification of items or services furnished by the supplier, (3) control of nonconformances, (4) corrective action, (5) purchaser's acceptance of items and services, (6) quality assurance records and (7) audits. Most attention is devoted to items (1), (2) and (5) because other modules of Course 31, Quality Assurance Practices, describe quality assurance programs applicable to the other items.



## MODULE PREREQUISITES

The student shall have completed Module 31-1.



## OBJECTIVES

Upon completion of this module, the student/trainee can:

1. Define:
  - a. purchaser
  - b. supplier
  - c. designated representative
  - d. procurement document
  - e. right of access
2. State the purpose of the purchaser's program for the selection of procurement sources.
3. Briefly describe the purchaser's program for the selection of procurement sources including the methods of (a) quality history, (b) current quality information, and (c) on-site review.
4. State the purpose of a bidders list and describe its content and use.
5. Describe what constitutes a solicitation for bid.
6. State the purpose of bid evaluation applicable to (a) technical considerations, (b) quality assurance, (c) supplier personnel, (d) supplier production capacity, and (e) exceptions.
7. State the overall purpose of the Purchaser's postaward activities.
8. Name four activities of the Purchaser used for evaluating supplier performance and describe the role of each.
9. State the purpose of notification points and describe how they are established.

10. Name five elements of the Purchaser's verification activities and describe the role of each.
11. Name four methods of Purchaser's acceptance of items or services furnished by suppliers and briefly describe how each is accomplished.





# SUBJECT MATTER

## PREAWARD ACTIVITIES

### Definitions

Unique terms used in this module are defined as follows:

- Designated Representative - An individual or organization authorized by the Purchaser to perform functions in the procurement process.
- Procurement Document - Purchase requisitions, purchase orders, drawings, contracts, specifications or instructions used to define requirements for purchase.
- Purchaser - The organization responsible for establishment of procurement requirements and for issuance, administration, or both, of procurement documents.
- Quality Assurance Program Requirements - Those individual requirements listed in ANSI N45.2 which when invoked in total or in part establish the requirements of a quality assurance program.
- Quality Assurance Records - Those records which furnish documentary evidence of the quality of items and of activities affecting quality.
- Right of Access - The right of a Purchaser or designated representative to enter the premises of a Supplier for the purpose of inspection, surveillance, or quality assurance audit.
- Services - The performance by a Supplier of activities such as design, fabrication, inspection, non-destructive examination, repair, or installation.
- Subtier Procurement - Procurement by a Supplier from a subsupplier of items or services.
- Supplier - Any individual or organization who furnishes items or services to a procurement document.

It includes the terms Vendor, Seller, Contractor, Subcontractor, Fabricator, Consultant, and subtier levels.

- Surveillance - The physical presence to monitor by observation the designated activities to assure that they are performed in a specified manner.

### Types of Preaward Activities

Preaward activities are those measures taken by a Purchaser which result in placement of a contract with a supplier. These measures are intended to ensure that contracts are placed with those suppliers who demonstrate the ability to successfully fulfill the contract. Preaward activities consist of activities associated with (1) selection of procurement sources and (2) bid evaluation and award.

The preaward activities associated with selection of procurement sources result in "qualifying" prospective suppliers. The qualification is not a certified qualification resulting from qualification testing which one might normally associate with the qualification. Instead, qualified suppliers are those who are considered by the Purchaser as capable of satisfactorily providing products or services. The Purchaser determines the criteria by which suppliers are considered qualified.

The preaward activities associated with bid evaluation and award result in placing a contract with the successful bidder. Again, the Purchaser determines the specific measures for evaluating each bid and determining which supplier will receive the contract award. The Purchaser awards the contract based on determination of the supplier whose bid and capabilities best fulfill the requirements of procurement documents at an acceptable cost.

Preaward activities are illustrated by Figure 31-2-1.

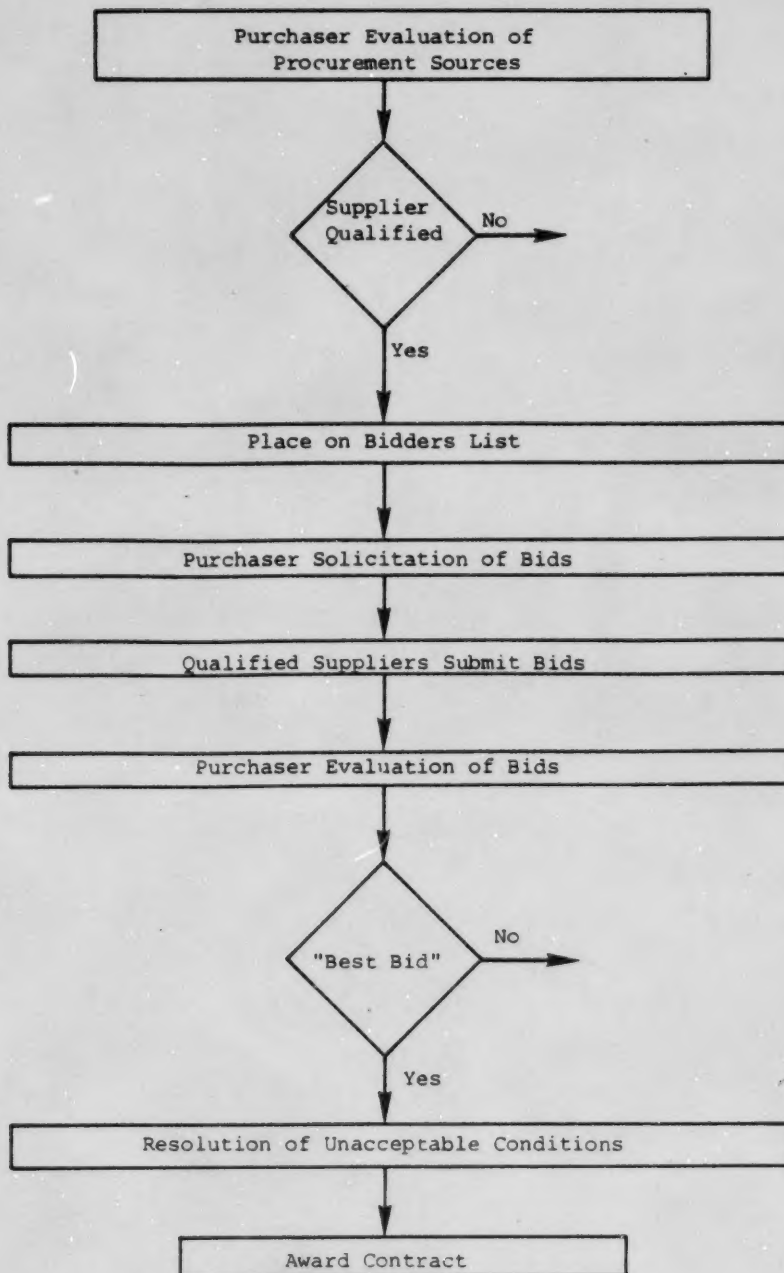


Figure 31-2-1. Preaward Activities

## SELECTION OF PROCUREMENT SOURCES

### Purpose of Selection

The owner of the nuclear power plant, and all tiers of subcontractors and suppliers from the owner, purchase necessary materials, components, and services which are not available within their own internal resources of a given company. Each such purchaser has a vital interest in obtaining products and services which fully comply with requirements of procurement documents. This interest is threefold. The purchaser desires (1) economy, (2) compliance with schedule, and (3) quality products and services. Thus, selection of suppliers for potential use predetermines those suppliers who are deemed by the purchaser as having the capability to furnish quality products or services on time at competitive prices. The results of the predetermination typically are documented in the form of a "bidders list".

### Bidders List

Each purchaser maintains a bidders or qualified vendor list which lists those suppliers considered by the purchaser as a qualified supplier. The process of supplier selection results in decisions to add or not add suppliers to the bidders list. Whenever a need arises to proceed with a procurement, the bidders list provides a convenient listing of qualified suppliers from whom bids may be solicited.

Suppliers are categorized on bidders lists by products and services for which each is considered qualified. Such categorization provides for quick identification of suppliers considered qualified for a given product or service. Examples of categories include:

- Design and Engineering (i.e., nuclear, civil, electrical, mechanical, analyses)



- Code components (i.e., pressure vessels, pumps, valves, piping, storage tanks, and heat exchangers)
- Electrical components (i.e., generators, motors, switchgear, controllers, relays, and instrumentation)
- Processes (i.e., welding, heat treating, plating, destructive testing, and nondestructive testing)

### Selection Process

Selection of suppliers is based on evaluation of their capability to provide items or services in accordance with the requirements of the procurement documents. Purchasers establish within their quality assurance program internal responsibilities for determining supplier capability. More than one department may have defined responsibilities for such determination. For example, Purchasing Department may be responsible for determining financial stability of suppliers, Engineering Department may be responsible for determining adequacy of the supplier's facilities, equipment, processing, and technical expertise, and Quality Assurance Department may be responsible for determining the adequacy of the supplier's quality assurance program.

Purchasers describe within their quality assurance program the methods for evaluating supplier capability and the results therefrom. Methods used for evaluation include any or all of (1) evaluation of historical records of performance on same or similar products and services, (2) evaluation of current quality information furnished by the supplier, and (3) evaluation of the supplier's capabilities by on-site reviews.

Evaluation of historical records of performance to determine a supplier's capability examines history of the supplier with the purchaser or with other purchasers. The evaluation determines if the supplier has furnished the same or similar product or service in a generally satis-

factory manner. Recent experience with the supplier is of most concern. While "recent" has various significance, experience within the past year or two is of most concern. Objective evidence of recent supplier experience is provided by (1) records of supplier performance on recent contracts, (2) performance of supplier's product in service, or (3) experience reported by other users of the supplier's product or service.

Evaluation of current quality information furnished by the supplier to determine the supplier's capabilities involves a request to the supplier to furnish necessary information. Preplanned questionnaires are often used for this purpose. The questionnaire requires a senior management official of the supplier to certify that the information furnished is complete and accurate. Questionnaires typically require information as follows.

- manufacturing capabilities including number and type of machines and reserve capacity.
- processing capabilities such as welding, heat treatment, cleaning, plating, and painting.
- test capabilities including functional testing, destructive testing, and nondestructive testing.
- codes, standards, and specifications previously complied with
- quality assurance program including submittal of the QA Manual and QA Procedures.
- personnel resources
- other purchasers who have received same or similar products or services.

Evaluation of supplier's capabilities by on-site review involves a visit by the Purchaser to directly examine the supplier's capabilities. The Purchaser may send a team comprized of a representative of engineering, purchasing, and quality assurance departments. These visits evaluate

the same types of information as requested by preplanned questionnaires.

One can sense that the three methods of evaluation may result in three "levels of confidence" in the supplier's capabilities. While this may be true, one can argue that satisfactory service of product (first method) is more reliable than on-site evaluations (third method). One could also argue that on-site evaluation is best because it directly views present supplier capabilities. On the other hand, supplier certification of capabilities (second method) provides current information and tends to put the supplier's reputation "on the line". The consensus is that each of the three methods have merit and that each Purchaser must use the method, or combination of methods, which convinces that Purchaser of the supplier's capabilities. In general, as complexity of product or services increases, the amount of information obtained on the supplier's capabilities increases.

## BID EVALUATION AND AWARD

### Solicitation for Bids

At the time of need to contract for product or services, the Purchaser solicits bids from prospective suppliers. With certain exceptions, the solicitation for bids is a formal process. The Purchaser assembles the procurement documents which specify the desired product or service to be purchased and all technical, quality, and contractual provisions which will apply to the successful bidder. The assembled procurement "package" is issued to prospective suppliers who have been previously determined to be qualified for the scope of work to be contracted. Prospective suppliers are obtained from an established bidders list, or if a bidders list has not been maintained, the selection

process is pressed into service to establish a listing of qualified suppliers.

Formal solicitations for bids are unnecessary in certain instances. One category where this is true is "catalog product". Catalog product refers to standardized product designs offered routinely by suppliers. If the Purchaser determines that the standard product suffices, the solicitation process may simply be telephone calls to qualified suppliers to determine price and delivery date. Another category is consulting services. The Purchaser may not have the time or experience to prepare procurement documents which delineate the full extent of consulting services desired. Qualified consultants are requested to submit bids which detail the consultant's services proposed to meet the Purchaser's needs. The submittal by the successful consultant then becomes part of the procurement documents. The first submittal is often altered by negotiation before the order is placed.

A unique condition exists if only one supplier is qualified to bid. Such conditions are termed "sole source" and are generally undesirable from the Purchaser's viewpoint. If a sole source situation exists, only the qualified supplier is requested to bid. In such cases, Purchasers encourage other suppliers to become qualified for the product or service involved.

#### Bid Evaluation and Award

The Purchaser establishes methods and assigns internal responsibilities for evaluating bids received. Evaluation of bids has the objective of selecting the supplier whose bid most fully complies with requirements of the procurement documents and offers a reasonable price. Evaluation of bids is made by professional judgement and it may or may not include a numerical ranking system. Numerical ranking systems, when used, consist of predetermined



ranges of numerical values which are credited to each bid in proportion to the excellence of the bid. For example, a 100 point system might permit allocation of 0-30 points for technical, 0-30 points for quality, 0-20 points for schedule, and 0-20 points for a cost-effectiveness ratio such as the quotient of cost divided by the sum of the other points. Whether the evaluation involves numerical ranking or not, the evaluation assesses (1) technical considerations (2) quality assurance, (3) research and development effort, (4) supplier's personnel, (5) supplier's production capability, (6) supplier's past performance, (7) alternates, and (8) exceptions. In addition, the Purchaser typically considers other factors such as warranties, proposed terms and conditions, schedule, and costs. Nonetheless, the eight enumerated items are those with largest effects on quality.

Technical considerations involve evaluation of the bidder's proposal in terms of the codes, standards, specifications and drawings applicable to the procurement. The evaluation determines the supplier's (1) understanding of these documents, (2) ability to comply with these documents, (3) previous experience in working to these documents.

Evaluation of bids for quality assurance requirements involve determining if the bidder has established a quality assurance program which satisfies the requirements of the procurement documents. The evaluation determines if (1) the scope and content of the supplier's QA program coincides with that required by the procurement documents, (2) ample vendor planning is identified to ensure accomplishment of required inspections and tests, (3) supplier plans are identified for requiring appropriate QA programs of subcontractors, and (4) Purchaser's right of access is acknowledged by the supplier.

Evaluation of research and development efforts is performed when some portion of the contract requires appli-

cation of technology which is not presently found in production or which is beyond the current "state of the art". Examples of such cases include new designs, design modifications to resolve historical problems, and new analyses of design. In such cases, the evaluation determines the supplier's (1) design capabilities, (2) proof of analytical models, (3) plans for design qualification testing, and (4) access to resource materials.

Evaluation of supplier's personnel determines if required skills are available in sufficient numbers to accomplish the work. Types of skills include design engineering, manufacturing engineering, civil engineering, electrical engineering, quality engineering, craftsman, (e.g., machinists, welders, pipe fitters, electricians, etc.), inspectors (e.g., mechanical, electrical, civil), testers (e.g., functional, destructive, nondestructive), and others (e.g., schedulers, coordinators). In addition, the evaluation determines if personnel are qualified or plans are identified for qualifying personnel where procurement documents require formal qualification of personnel, such as welders and nondestructive testing personnel.

Evaluation of supplier's production capabilities determine if production and processing equipment and facilities are adequate to produce product which complies with procurement documents and whether sufficient reserve processing capacity exists to meet schedular commitments. This evaluation considers each type of processing which will be necessary to produce the product. Examples include metal forming, machining, welding, heat treating, brazing, soldering, wiring, assembly, fitting, cleaning, coating, testing, inspecting, handling, and packaging. Supplier's plans for subcontracting for such capability are also evaluated.

Evaluation of supplier's past performance may have

been completed in sufficient detail during the process of selection of qualified bidders. Further evaluation of supplier past performance is made as necessary to verify past performance identified in the supplier's bid which has not been previously verified. The evaluation determines if such prior performance was generally satisfactory in terms of procurement documents.

Evaluation of alternates is applicable whenever a supplier proposes alternative products, methods, or services to those required by the procurement documents. The evaluation determines the acceptability of the alternate and advantages to the Purchaser for accepting the alternate. Evaluation of alternates also connotes alternatives available to the Purchaser upon completion of bid evaluation. The Purchaser compares strengths and weaknesses of all bids and considers the impact on the Purchaser caused by each weakness. Such evaluation determines alternative courses of action by the Purchaser to arrive at a procurement award. Examples include requests for rebid, further negotiation with the "best" bidder, and modification of the procurement documents.

Evaluation of exceptions is applicable whenever a supplier takes exception to requirements of the procurement documents. The appropriate representative of each discipline reviews the supplier's basis for each exception, and determines the technical acceptability of allowing such exception on the basis of requirements of the appropriate technical or quality specification.

Unacceptable conditions determined by evaluation of bids are compared for each bidder to commence a process of elimination. The Purchaser may notify bidders of unacceptable conditions and request revised bids. In such case, evaluation of bids is repeated upon receipt of the revised bids. In lieu of requesting revised bids, the Purchaser may select

one supplier as the most successful bidder. In either case, the Purchaser obtains resolution or commitments for resolution of unacceptable conditions prior to awarding the contract to the successful bidder. Such resolution or commitment for resolution is added to the procurement documents package and made part of the contract.

## POST-AWARD ACTIVITIES

### Purpose

The Purchaser always has the responsibility of determining acceptance of suppliers' products and services. In order to make this determination, the Purchaser plans and implements post-award activities which develop a basis for ultimate acceptance of items or services furnished by the supplier. While the basis for acceptance may be established by a single decision point, more often than not it is the cumulative results of many post-award activities.

### Types of Post-Award Activities

The extent of post-award activities is dependent on the uniqueness and complexity of the procurement and on the known performance of the supplier. Frequency of procurement with a given supplier may also influence the extent of post-award activities. In any event, Purchasers plan for the post-award activities to be implemented and adjust these plans as necessary during the life of the procurement in an effort to be able to accept items or services delivered by the supplier. Seven types of activities are considered by the Purchaser's planning as follows:

- Purchaser evaluation of supplier performance.
- Purchaser verification of supplier product and services.
- Control of nonconformances.
- Corrective Action.
- Purchaser's acceptance of items or services.
- Quality assurance records.
- Audits.



## PURCHASER EVALUATION OF SUPPLIER PERFORMANCE

### Scope

Purchaser evaluation of supplier performance commences at contract award and continues until final delivery of items or services under that contract. However, except for possibly a few very large contracts, it does not require full-time commitment by Purchaser's personnel. The activities for evaluating supplier performance are planned and scheduled as deemed necessary by the Purchaser and consistent with requirements of applicable regulations, codes and standards. These activities include (1) establishment of an understanding of contract provisions, (2) requirements for the supplier to identify planning techniques and processing, (3) review of documents generated by the supplier, (4) identification and processing of change information, and (5) establishment of an exchange of documents method between Purchaser and supplier.

### Establishment of Understanding of Contract Provisions

It is in the best interest of the Purchaser to ensure that the supplier understands the provisions of the contract. When suppliers have a complete understanding of contractual provisions at the outset, it is more probable that adequate planning will be made by the supplier without omissions.

The need for actions beyond resolving items resulting from bid evaluation and award is dependent on the complexity of the contract. As a minimum, Purchasers require the supplier to sign and return an acknowledgment copy of the contract. While this serves primarily as a legal binder, it also attests to the supplier's understanding and acceptance of the contract. For more complex contracts, one or more meetings may be held to review contractual pro-

visions and methods of complying with such provisions.

#### Supplier Identification of Planning and Processing

For complex work, the contractual provisions require the supplier to identify plans for accomplishing the work required by contract and the processing to be used in manufacture, inspection and test activities. Such planning and processing is developed in conjunction with or soon after contract award. The Purchaser evaluates subsequent supplier performance to such planning and processing.

Supplier planning identifies and schedules all major work items necessary for accomplishment of the contractual scope of work. This planning is sometimes termed "contract schedule of events", "milestones", or "master contract schedule". As appropriate to the contract, it identifies and schedules major tasks in the following areas:

- Placement of subtier procurements.
- Preparation of detailed processing instructions.
- Performance of qualifications of procedures and personnel.
- Preparation of drawings, procedures, specifications, and manuals.
- Planning for final inspections and tests.
- Submittal of progress reports.
- Identification of shipment schedule.

Supplier processing identifies the sequential steps for fabrication, inspection, and test of product to be delivered. Suppliers typically develop processing in two steps. First, a sequential outline of major processing steps is prepared. It is this outline which is typically submitted to the Purchaser. Then detailed processing instructions are prepared for use by the supplier's crafts personnel in fabricating, inspecting, and testing the product.

Contracts typically require submittal of planning and

processing for information although sometimes contracts require Purchaser approval of these submittals. In either case, the Purchaser evaluates the submittals for (1) completeness, (2) consistency with contract technical, administrative, and schedular provisions, and (3) identification of Purchaser's notification points. At designated notification points, the supplier is required to provide a few days advance notification to the Purchaser of the specific time such points will be reached. In this manner, the Purchaser identifies early in the life of the contract those processing steps which will be witnessed or inspected by the Purchaser's designated representative.

#### Review of Supplier Documents

Contracts often require submittal of documents in addition to delivery of hardware. Examples of such documents include technical manuals, product drawings, engineering reports of analyses or tests, and supplier inspection and test reports. Procurement documents specify those supplier generated documents which must be submitted to the Purchaser. The Purchaser assures that measures are established for the control, handling, and approval of supplier generated documents.

Supplier generated documents typically have specific value to subsequent activities by the Purchaser. For example, technical manuals contain instructions for the storage, handling, installation and operation of product which are applicable to the Purchaser's use of the product. Supplier generated drawings provide product dimensions which must be known by the Purchaser to establish interfaces with other product. Accordingly, the Purchaser establishes measures for the acquisition, processing, and acceptance of supplier generated documents.

Measures established by the Purchaser assure that

suppliers provide required documents on time and that approval of these documents is recorded. Supplier submittals are monitored against the supplier's planning documentation for compliance with schedule. Purchaser's internal measures typically include a log of documents received and status of Purchaser's review and approval of the documents. These measures ensure that revisions to documents submitted by the supplier receive the same review and that approved revisions replace the previously submitted document.

#### Identification and Processing of Change Information

Changes to procurement documents are sometimes necessary after contract award. Design changes, approved changes requested by the supplier, and changes requested by the customer of the Purchaser are causes of changes. The Purchaser is responsible for initiating changes to the contract whenever approved changes to procurement documents affect the procurement action. This responsibility is carried out in conjunction with the Purchaser's document control system. That is, the Purchaser evaluates changes to documents for impact on procurements at the same time such changes are evaluated for acceptability.

Whenever changes to procurement documents affect the procurement, the approved change is issued to the supplier in the form of an amendment to the contract. Supplier acknowledgement of the contract amendment certifies supplier's understanding and commitment to the change. Dependent on the scope of the change, it may be necessary to adjust costs, schedule, supplier planning and processing, and Purchaser's notification points.

#### Exchange of Documents Method

The Purchaser establishes with the supplier the precise



method of exchange of documents during the life of the contract. The method includes identification of persons in each organization who serve as focal points for exchange of documents. In this manner a standard distribution list is established for each type of document. Persons designated to serve as focal points are in turn responsible for internal distribution within the organization. In addition to focal points, the method may also include special forms for transmittal of documents. Such forms are uniquely serialized and permit convenient tracking of and reference to specific documents.

#### PURCHASER VERIFICATION AND ACCEPTANCE OF SUPPLIER PRODUCT AND SERVICES

##### Scope

Purchaser evaluation of supplier performance, as previously described, evaluates overall supplier performance in terms of planning, scheduling, commitment of resources, and achievement of milestones to assure that these activities are accomplished in a satisfactory manner requires verification by the purchaser's quality representative.

Three methods of verifications are considered by the Purchaser: (1) surveillance, (2) inspection, and (3) audit. Surveillance and audit are performed at the supplier's facility. Inspection is performed at receiving or at the supplier's facility or both. Either surveillance or inspection at the supplier's facility typically involve notification points. These notification points are based on the Purchaser's plans for verification of supplier's products and services.

The extent of verification activities varies with product complexity and ability to accept the product upon receipt. Elements of the Purchaser's verification activities are (1) source verification planning, (2) receiving inspection

tion planning, (3) audit planning, (4) measuring and test equipment, (5) personnel qualifications and (6) reporting.

#### Source Verification Planning

Source verification planning identifies the inspections, tests, notification points, acceptance criteria and documentation to be used by the Purchaser to verify product and services at the supplier's facility. Procurement documents and supplier's planning and processing procedures are reviewed to determine those source verifications to be performed. Source verifications are typically planned whenever one or more of the following conditions occur:

- The product is vital to plant safety.
- Product quality characteristics are difficult or impossible to verify after delivery.
- Complex design, manufacture, or test activities are performed by the supplier.

Source verifications have the objectives of verifying that the supplier is properly performing fabrication, inspection, and test activities and confirming product acceptability by independent inspection. A large portion of source verification is addressed at the first objective, i.e., verifying supplier activities. By periodically verifying supplier activities, an assurance of product acceptability is obtained with minimal demand on the Purchaser's personnel resources. Where actual inspection of product is planned, the Purchaser has the option of witnessing the supplier's inspection and test or of performing independent inspection and test. In general, source verifications include verification that:

- Supplier generated documents are complete, reviewed, and approved as required.
- Fabrication procedures and processes are complied with.

- Applicable qualifications, records, and certifications are available, complete, and acceptable.
- Product is inspected and tested by the supplier as required and associated records are available, complete, and acceptable.
- Nonconformances are dispositioned in accordance with provisions of the contract.
- Product is cleaned, preserved, packed, and identified as required by procurement documents.
- Results of independent inspections and tests by the Purchaser's designated representative agree with results obtained by the supplier.

#### Receiving Inspection Planning

Receiving inspection planning identifies the characteristics to be verified and the supplier documentation to be reviewed upon receipt of items furnished by a supplier. Receipt inspections normally do not duplicate source verifications and the extent of receipt inspection varies with product complexity and importance to safety. In general, items are receipt inspected as a minimum, for (1) type, quantity, and identification, (2) evidence of no shipping damage, and (3) acceptability of accompanying test reports or certificates of compliance. Receiving inspection will be described fully in the next module of this course.

#### Audit Planning

Purchasers plan for audits of suppliers based on essentially the same criteria as for source verifications. However, regulatory commitments may require annual or triennial audits of suppliers of safety related components. In general, audits are focused toward those suppliers who continuously furnish products or whose products require more than a year to fabricate. Product acceptance by the

Purchaser is rarely based solely on audits of suppliers. Instead, audits augment the source verification or receiving inspection plans by critically evaluating the supplier's quality assurance program.

#### Measuring and Test Equipment

Measuring and test equipment used by the Purchaser's designated representative must be suitable and calibrated. Suitability refers to the capability and accuracy of the equipment, i.e., it must be capable of making the measurement or test required and its readout must be of an accuracy finer than the tolerance of the measured feature. Normally, accuracy of 25% or less of the tolerance is required. Calibration refers to the ability to trace the equipment's accuracy to a national standard or to a recognized physical constant.

Measuring and test equipment used for performing source verifications are typically provided by the supplier. In such cases, it is incumbent on the Purchaser's designated representative to verify that such equipment is suitable and calibrated within the supplier's calibration program. Measuring and test equipment used for receiving inspection are typically owned, selected, and calibrated by the Purchaser. In the event measuring and test equipment is found to be out of calibration, the Purchaser evaluates the validity of previous inspections or tests by the designated representative with that equipment. The evaluation considers the extent of inaccuracy of the equipment, and the tolerance of measured features, and determines if inspections or tests must be repeated. The results of the evaluation are documented.

#### Personnel Qualifications

Persons who perform source evaluations, verifications and receiving inspections for the Purchaser are qualified as required



by applicable codes and standards. The Purchaser, or an agent thereof, certifies personnel qualification based on individuals' training, experience, and scores on qualification examinations.

### Reporting

Performance of verification activities is reported in all instances. Reports are initiated for source verifications, receiving inspections, and audits. In addition, Purchaser's actions with respect to nonconformances, dispositions, waivers, and corrective action are documented.

## CONTROL OF NONCONFORMANCES

### Scope

The Purchaser and supplier establish and document measures for the identification, control, and disposition of items and services that do not meet requirements of procurement documents. Supplier responsibility for control of nonconformances and measures for Purchaser's actions on nonconformances are specified within provisions of the contract. The Purchaser verifies compliance with such contractual provisions.

### Provisions

Provisions for the supplier's control of nonconformances require the supplier to implement a documented procedure for identification, control, and disposition of nonconformances. Identification includes tagging, labeling, or marking of the nonconforming item and the initiation of a nonconformance report which describes the nonconformance. Control measures are procedural requirements which prohibit use of the nonconforming item prior to disposition of the nonconformance. Disposition involves evaluation by the

supplier and, in certain cases, approval by the Purchaser. Disposition options are scrap and replace, rework, repair, and accept "as-is".

The supplier's documented procedure assigns responsibilities for dispositioning nonconformances. Typically, engineering and quality assurance departments are responsible. The disposition selected is based on whether the nonconformance or rework or repair thereof affects fit, function, or interchangeability. If these factors are unaffected, accept as-is may be appropriate. Rework or repair dispositions are appropriate if such rework or repair restores the item to a conforming or acceptable status respectively. Scrap and replace is appropriate when repair is impracticable. The Purchaser is responsible for verifying that suppliers' control of nonconformances results in acceptable product or services. To facilitate this verification, contractual provisions require the supplier to obtain Purchaser approval of dispositions prior to their implementation. Typically, Purchaser approval of the supplier's disposition of nonconformances is required whenever any of the following occur:

- violation of technical or material requirement of procurement documents.
- violation of a supplier document which was approved by the Purchaser.
- disposition by repair.
- inability to conform with the original requirement even though rework or repair restores functionality.

The Purchaser acts on supplier nonconformance reports in accordance with a documented procedure. This procedure assigns responsibilities for review and disposition of the supplier's recommendations, verification of supplier's implementation of Purchaser's disposition, and maintenance of records of supplier nonconformances. The flow of these activities are illustrated in Figure 31-2-2.

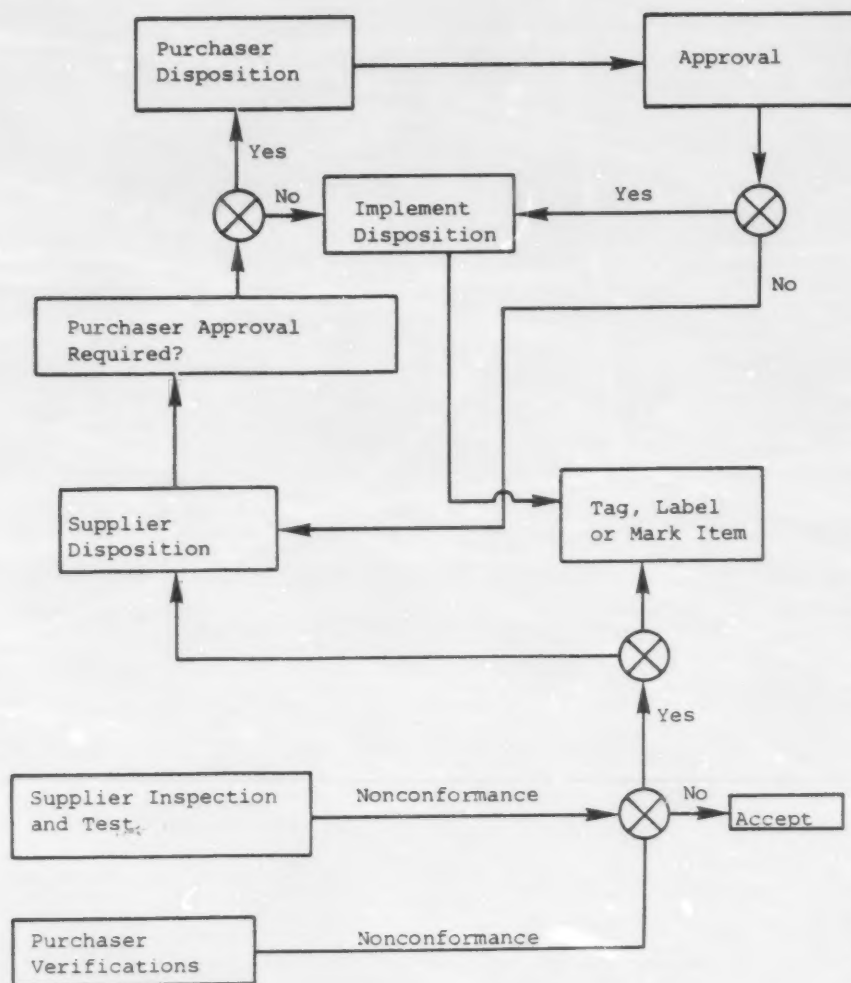


Figure 31-2-2. Disposition of Nonconformances

### CORRECTIVE ACTION

#### Scope

The Purchaser and the supplier are responsible for establishing documented measures for providing timely corrective action on conditions adverse to quality. The

supplier's corrective action applies to adverse conditions which are the responsibility of the supplier. Likewise, the Purchaser's corrective action applies to adverse conditions which are the responsibility of the Purchaser. In addition, the Purchaser is responsible for verifying that the supplier implements a corrective action system.

#### Provisions

Significant conditions adverse to quality are eliminated by the process of corrective action. This process includes (1) identification of deviations and nonconformances, (2) review and evaluation of the conditions which caused such deviations and nonconformances, (3) corrective action to eliminate significant conditions which cause deviations and nonconformances, (4) report of such actions to management, and (5) follow-up to verify implementation of corrective action. The Purchaser's and supplier's corrective action systems assign responsibilities for identification of deviations and nonconformances and for evaluating conditions to determine the need for corrective action beyond correcting the specific deviation or nonconformance.

Identification of deviations and nonconformances is a function of inspection, test, surveillance, and audit. Individuals performing these activities issue reports which document the activity and identify any deviations and nonconformances. To facilitate disposition of deviations and nonconformances, a separate report is typically issued. Evaluation of these reports for significant adverse conditions may be the responsibility of the affected department or of a centralized group such as quality assurance department.



## PURCHASER'S ACCEPTANCE OF ITEM OR SERVICE

### Scope

The Purchaser establishes a method of acceptance of items or services furnished by suppliers. While the supplier is responsible for furnishing items and services in compliance with procurement documents, the Purchaser determines acceptability of items and services at the point in time where ownership of the product transfers to the Purchaser. Once accepted, the product belongs to the Purchaser. Any subsequent problems with the product typically represent supplier responsibility only as provided by warranty.

Purchaser acceptance is based on one or more of the following:

- Acceptance of certificate of conformance
- Acceptance by source verification
- Acceptance by receiving inspection
- Acceptance by post installation test
- Acceptance by evaluation of service.

Procurement documents specify the point of acceptance. The Purchaser's programs for evaluation of supplier performance, verification of items and services, control of nonconformances, and corrective action are planned in such a manner as to provide the basis for acceptance at the designated point.

### Acceptance by Certificate of Conformance

Purchaser's acceptance of product or services based solely on supplier's certificate of conformance involves the least evaluation and verification by the Purchaser. This method is acceptable when not prohibited by regulations, codes and standards and when the item or service is of simple design and involves standard materials, processes and test. Where acceptance is by certificate of compliance, the Purchaser establishes the following contractual provisions

to govern the supplier's submittal of the certificate:

- Identification of purchased items.
- Identification of codes, standards, specifications, and drawings met by the purchased items including identification of approved changes, waivers, or deviations.
- Identification of nonconformances, if any, and disposition of each.
- Signature of supplier individual designated as responsible by the supplier's quality assurance program to attest to the accuracy and completeness of the certificate.
- Description of the certification system in the supplier's quality assurance program.

Certificates of Conformance submitted in accordance with contractual provisions are reviewed by the Purchaser for acceptance. The Purchaser also reviews supplementary data reports as may be required by procurement documents to accompany the certificate. Examples of data reports are material test reports, inspection records, and test reports which identify quantitative and/or qualitative data. If the certificate is verified as in compliance with contractual provisions, the corresponding items or services are accepted.

Purchasers also establish means of periodically verifying the validity of suppliers' certificates of conformance. Such verifications may include periodic audits of the supplier or independent inspection and test of a sample of the items. The interval of conducting these verifications is periodically adjusted to be commensurate with the supplier's quality history.

#### Acceptance by Source Verification

Purchaser acceptance of items and services by source verifications typically applies when the item or service

is (1) vital to plant safety, or (2) difficult to verify quality characteristics after delivery, or (3) complex in design, manufacture, and test. Prior to delivery of such items, the Purchaser's designated representative verifies that source verification of acceptability has been completed and that deviations and nonconformances have been properly resolved. Upon completion of this verification, the designated representative reports to the Purchaser the satisfactory completion of source verification activities. Based upon this report, the Purchaser accepts the item, authorizes delivery, and notifies the point of receipt of acceptability of the item.

#### Acceptance by Receiving Inspection

Purchaser acceptance solely by receiving inspection applies when the item or service is (1) relatively simple and standard in design, manufacture, and test, (2) adaptable to standard inspections and/or tests after delivery, and (3) do not require inspections or tests which would adversely affect the integrity, function, or cleanness of the item. In addition to acceptance solely by receipt inspection, those items subject to source verifications may also be accepted at receiving inspection. In such cases, the designated representative reports accomplishment of source verifications but acceptance is delayed until accomplishment of receiving inspection.

#### Acceptance by Post Installation Test

Purchaser acceptance by post installation test is always preceded by source verification, receiving inspection, or supplier certificate of compliance. This acceptance method applies with (1) it is difficult to verify quality characteristics of the item unless it is installed and in use, or (2) the item requires integrated check out or test

with other items, or (3) the item cannot demonstrate its ability to perform its intended function except when in use. Examples of such items are fuel cells and steam generators. The post installation test requirements and acceptance criteria are mutually established between the Purchaser and the supplier.

#### Acceptance of Services

The previous methods of acceptance primarily apply to Purchaser's acceptance of hardware items and associated services. However, some procurements are for services only. Examples include third party inspection, engineering and consulting services, and installation, repair, overhaul, or maintenance work. Acceptance of services only is based on one or more of (1) technical verification of data produced, (2) surveillance and/or audit of the activity, and (3) review of supplier's reports such as certifications and analysis reports.

### QUALITY ASSURANCE RECORDS

#### Scope

The Purchaser is responsible for establishing internal measures for the control of Purchaser generated QA records and for specifying within procurement documents the supplier responsibilities for supplier generated QA records. In addition, the Purchaser's procurement documents specify those supplier generated QA records which are required to be submitted to the Purchaser. Typical records with respect to Purchaser's qualification, evaluation, and verification of suppliers and those submitted by the supplier to the Purchaser are listed in Table 31-2-1.



Table 31-2-1

| TYPICAL PROCUREMENT QUALITY ASSURANCE RECORDS |                                          |                                          |                            |
|-----------------------------------------------|------------------------------------------|------------------------------------------|----------------------------|
| Purchaser Generated Records                   |                                          |                                          | Supplier Generated Records |
| Supplier Qualification                        | Evaluation of Supplier                   | Verification of Items                    |                            |
| Prior receipt inspection results              | Procurement document and changes thereto | Source verification records              | Planning                   |
| Prior source verification results             | Reports of meetings                      | Receiving inspection records             | Processing                 |
| Prior QA audits                               | Approvals of supplier Submittals         | QA audit records                         | Nonconformance reports     |
| Other users reports                           |                                          | Installation inspection and test records | Inspection records         |
| Supplier QA Manual                            |                                          | Product performance records              | Test records               |
| Supplier QA procedures                        |                                          |                                          | Certificates of compliance |
| Product failure reports                       |                                          |                                          |                            |
| On-site direct evaluation reports             |                                          |                                          |                            |

### Provisions

Supplier generated QA records are either retained by the supplier or submitted to the Purchaser as specified by procurement documents. For those retained by the supplier, the procurement documents specify requirements for storage conditions, retrievability and retention time. Those forwarded to the Purchaser become the Purchaser's responsibility and are placed within the Purchaser's records management system. The Purchaser's system also includes defined requirements of storage, retrieval, and retention.

Regulatory requirements and provisions of codes and standards stipulate criteria for records management. In general, the criteria require retention of records which characterize the design, processing techniques, as-built condition, and function of the item or service. For each record to be retained, a retention period is assigned based on the stipulated criteria. Retention periods range from one year to end of service to life of product. Retrievability requirements are stated as "retrievable without undue delay".

## AUDIT OF PROCUREMENT PROGRAM

### Scope

The Purchaser's program of internal audits must include audit of the Purchaser's procurement program. The internal audit serves to evaluate the effectiveness of and compliance with the Purchaser's documented measures for preaward and postaward activities. In addition, the Purchaser's program of external audits schedules and performs audits of suppliers as considered necessary.

### Provisions

Internal audits of the procurement program are scheduled and performed by the same procedures as govern internal audits of other QA programs. Typically, these audits are performed annually. External audits of suppliers are typically performed either (1) once during the life of the contract, (2) annually, or (3) triennially when annual evaluations do not indicate the need for more frequent auditing.

All audits are performed in accordance with a documented program. The program provides for the preparation, performance, reporting, and follow-up of each audit. Preparation involves selection of lead auditor and audit team members, the development of a written plan or check list for performing the audit, and arrangements with the organization to be audited. Performance involves preaudit conference, evaluation of objective evidence of quality, and postaudit conference. Reporting involves preparation of an audit report and transmittal of the report to appropriate management levels. Follow-up involves obtaining corrective action response on audit findings and verification of implementation of such corrective actions.



## EXERCISES

The following exercises serve to reinforce the concepts presented in this module.

1. Obtain a marketing brochure from a local company and evaluate it to determine if the company could be considered as a qualified supplier. Use the checklist given in the Procedures given in this module to perform this evaluation.
2. Obtain from your instructor a copy of a company's quality assurance procedure for control of procurement of items and services. Using the Procedures given in this module evaluate this QA procedure.
3. Describe the purchaser's program for the selection of procurement sources including the methods of:
  - a. quality history
  - b. current quality information
  - c. on-site review
4. Explain briefly the purpose of a bidders test.
5. Briefly explain the purpose of bid evaluation applicable to:
  - a. technical considerations
  - b. quality assurance
  - c. supplier personnel
  - d. supplier production capacity
  - e. exceptions
6. What are four methods of Purchaser's acceptance of items or services furnished by suppliers?

7. Answer the following questions as either true or false:
- ☐ a. Qualified suppliers are those who are considered by the Purchaser as capable of satisfactorily providing products or services.
  - ☐ b. The process of determining qualification of suppliers is termed selection of procurement sources which has the purpose of predetermining those suppliers who are deemed by the Purchaser as having the capability to furnish quality products or services on time at competitive prices.
  - ☐ c. Selection of procurement sources establishes a bidders list which provides a convenient listing of qualified suppliers from which bids are solicited whenever the need arises for a procurement action. Suppliers are categorized on bidders lists by types of items and services for which they are considered qualified.
  - ☐ d. Evaluation methods used for selection of procurement sources include one or more of (1) evaluation of historical records of performance on same or similar items or services, (2) evaluation of current quality information furnished by the supplier, and (3) evaluation of supplier's capabilities by on-site reviews. Bid evaluation and award results in placement of a contract with the successful bidder.
  - ☐ e. Evaluation of bids include assessment of (1) technical considerations, (2) quality assurance, (3) research and development effort, (4) supplier's personnel, (5) supplier's production capability, (6) supplier's past performance, (7) alternates, and (8) exceptions.

- \_\_\_\_\_ f. Prior to award of the contract to the supplier who submitted the "Lowest" bid, the Purchaser obtains supplier resolution or commitment for resolution of unacceptable conditions, if any, noted by bid evaluation.
- \_\_\_\_\_ g. Notification points are those steps within supplier's processing at which the Purchaser requests notification prior to the supplier performing the step. Notification points are useful in assuring accomplishment of planned source verifications.
- \_\_\_\_\_ h. Purchaser's verification of supplier's items or services include the (1) product inspection planning, (2) shipping inspection planning, (3) postaward planning, (4) research equipment, (5) personnel qualifications, and (6) vendor qualification.
- \_\_\_\_\_ i. The Purchaser verifies supplier control of nonconformances by exercising approval authority over disposition of nonconformances and by source verifications or audits.
- \_\_\_\_\_ j. The supplier designates in procurement documents the point of acceptance and the acceptance criteria for items and services furnished by the purchaser.
- \_\_\_\_\_ k. The Purchaser method of acceptance of supplier's items or services is based on the complexity of the item or service and its importance to plant safety. Methods of acceptance are (1) acceptance by certificate of conformance, (2) acceptance by source verification, (3) acceptance by receiving inspection, (4) acceptance by post installation test, and (5) acceptance of services.





## MATERIALS

The following materials are required to support this module.

1. Marketing brochures from various companies.
2. Copies of various companies' quality assurance procedures on control of procurement of items and services.



## PROCEDURES

The following procedures refer to exercises 1 and 2 presented in this module.

1. Obtain a marketing brochure from a local company and evaluate it to determine if the company could be considered a qualified supplier. Use the following check list for the evaluation and identify types of information which are needed but not provided by the brochure:
  - a. name of supplier
  - b. item or service furnished by supplier
  - c. codes, standards, or specifications met by item or service
  - d. prior users of the product or service
  - e. inspection or test data which attests to performance of the item or quality of the service
  - f. warranties
  - g. supplier's quality assurance program
  - h. supplier's organization and staffing
  - i. supplier's manufacturing, inspection, and test facilities
  - j. supplier's control of subtier suppliers.

2. Obtain from the instructor a copy of a company's quality assurance procedure for control of procurement of items and services. Evaluate the procedure against the content of this module. Identify omissions and offer rationale for each omission. Identify noteworthy strengths and state why you considered it noteworthy. To assist you in your evaluation, the following items may be considered:
- a. acceptance of certificate of conformance
  - b. acceptance by source verification
  - c. acceptance by receiving inspection
  - d. acceptance by post installation test
  - e. acceptance by evaluation of service



## DATA TABLE

Not Applicable.



## REFERENCE MATERIALS

- NRC, Regulatory Guide 1.123, Quality Assurance Requirements for Procurement of Items and Services for Nuclear Power Plants, U.S. Nuclear Regulatory Commission, 1977
- NRC, Regulatory Guide 1.144, Auditing of Quality Assurance Programs for Nuclear Power Plants, U.S. Nuclear Regulatory Commission, 1979
- ASME, Quality Assurance Requirements for Control of Procurement of Items and Services for Nuclear Power Plants, ANSI N45.2.13, The American Society of Mechanical Engineers, 1976
- ASME, Requirements for Auditing of Quality Assurance Programs for Nuclear Power Plants, ANSI N45.2.12, The American Society of Mechanical Engineers, 1977
- Juran, J.M., Quality Control Handbook, McGraw-Hill, 1974



1. Define:
  - a. Procurement Document
  - b. Purchaser
  - c. Right of access
  - d. Supplier
2. State the purpose of selection of procurement sources.
3. Describe a bidders list including its purpose and use.
4. Describe the supplier selection process of evaluation of historical records of performance.
5. Describe the supplier selection process of evaluation of current quality information furnished by the supplier.
6. Describe the supplier selection process of evaluation by on-site review.

7. Briefly describe a Purchaser's actions in soliciting bids by formal inquiry.
8. State the purpose of each of the following subjects of bid evaluation:
  - a. technical considerations
  - b. quality assurance
  - c. research and development effort
  - d. supplier personnel
  - e. supplier's production capability
  - f. supplier's past performance
  - g. alternates
  - h. exception



9. State the overall purpose of purchaser's postaward activities.
10. Name five activities of the Purchaser used for evaluating supplier performance and describe the role of each.
  - a.
  - b.
  - c.
  - d.
  - e.
11. State the purpose of purchaser's notification points.
12. Briefly describe how notification points are established.

13. Name six elements of Purchaser's verification activities and briefly describe the role of each:

a.

b.

c.

d.

e.

f.

14. Describe the Purchaser's responsibilities with respect to nonconformances in suppliers' products or services.

15. Name five methods of Purchaser's acceptance of supplier's product or service and briefly describe how each is accomplished.

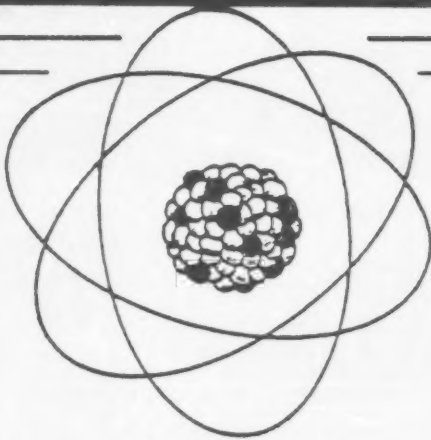
a.

b.

c.

d.

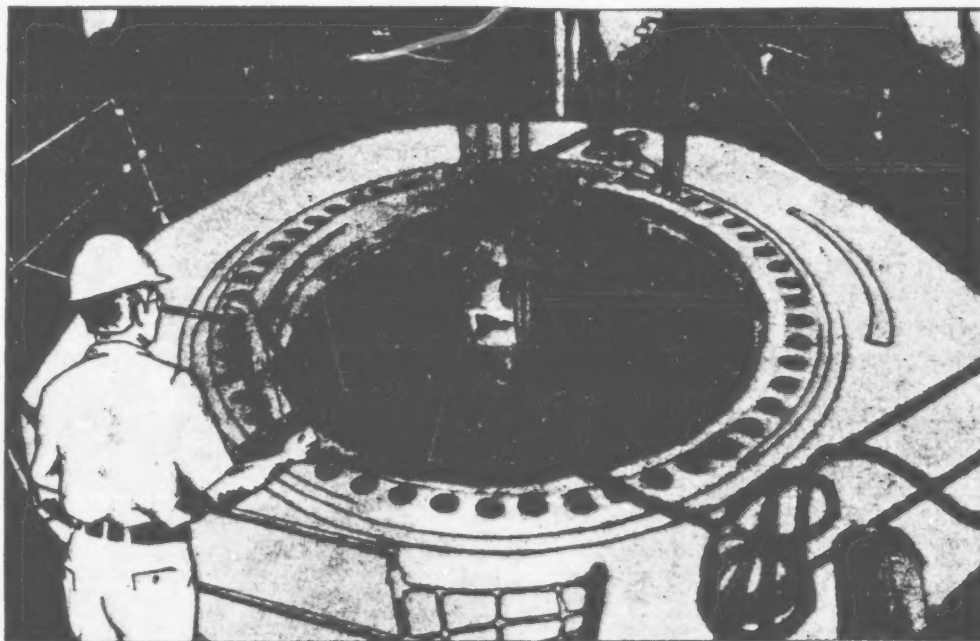
e.



# NUCLEAR TECHNOLOGY

## MODULE 31-3

### RECEIVING INSPECTION



## COURSE 31 QUALITY ASSURANCE PRACTICES



CENTER FOR OCCUPATIONAL RESEARCH AND DEVELOPMENT

4800 LAKEWOOD DRIVE WACO, TEXAS



## COURSE MODULES

### COURSE 31      QUALITY ASSURANCE PRACTICES

- MODULE 31-1      Overall Quality Assurance Program
- MODULE 31-2      Vendor Qualification
-  MODULE 31-3      Receiving Inspection
- MODULE 31-4      Identification, Storage and Handling  
                                 of Components, Parts and Materials
- MODULE 31-5      Non-Conforming Materials
- MODULE 31-6      Certification and Qualification of  
                                 Quality Control Inspectors
- MODULE 31-7      Auditing for Quality Assurance
- MODULE 31-8      Document Handling, Storage and  
                                 Retrieval for Quality Assurance

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## INTRODUCTION

The Nuclear QA/QC Technician can be assigned as a receiving inspector responsible for inspecting items as they are received. Later in his or her career, the technician may be responsible for preparing receiving inspection instructions which specify exactly what will be inspected. These responsibilities are extremely important because they result in determination of acceptance of received items. Payment of suppliers by the purchaser is predicated upon such determination.

Receiving activities are typically comprized of two organizations. One is responsible for inventory control and the other is responsible for inspection. This module describes this typical arrangement. The responsibilities of both groups are described with respect to inspection of received items. Attributes typically inspected are listed, inspection practices are described, and typical records are illustrated. In addition, handling precautions are described as they apply to receiving inspection.



## MODULE PREREQUISITES

The two previous modules, 31-1 and 31-2 should have been completed before proceeding to this one.



## OBJECTIVES

Upon completion of this module, the student/trainee can:

1. Name three functions typically accomplished by the receiving activity.
2. Describe the relative responsibilities for the receiving activity of Material Services Department, Quality Assurance Department, and Quality Control Department.
3. Describe inspection for shipping damage including typical attributes associated with this inspection.
4. Describe inspection for item identity including typical attributes associated with this inspection.
5. Name two types of paperwork which may accompany received items and which attests to the quality of the items; briefly describe the general content of each.
6. Describe inspection for item function including typical attributes associated with this inspection.
7. Name three levels of receiving inspection and briefly describe each.
8. Describe the uses of the following records:
  - a. QC Receiving Inspection Report
  - b. Conformance Tag
  - c. Nonconformance Tag
9. Inspect sample product in a simulated receiving activity.



## NOTES TO INSTRUCTOR / STUDENT

One of the Procedures included in this module recommends performance of receiving inspection of a packaged item. Items which can be used for this procedure may be incoming

items at your facility. Where possible, a copy of the purchase order for such items should be obtained and used during the inspection. In fact, many facilities insist that the purchase order (purchase requisition) be used during the inspection.



## SUBJECT MATTER

### THE RECEIVING ACTIVITY

#### Functions

Each purchaser of goods establishes a receiving activity to handle purchased items upon their receipt. Such receiving activities require planning to ensure that all necessary functions are accomplished for the complete range of items expected to be received. At the nuclear power plant construction site, a wide variety of materials, components, and equipment are received. The utility, prime construction contractor, and construction subcontractors may all have receiving activities accomplish similar functions.

Receiving activities are typically structured to accomplish three functions. First, it provides a basis for payment to the supplier for the received items. Results of receiving typically serve as the initiating cue to the purchasing department for payment to the supplier. Secondly, it provides evidence that received items are available for use. Work activities which require the received items are scheduled upon notice of receipt and acceptance. Thirdly, it determines the acceptability of received items. Both the purchasing department and the activity which uses the items must know that the items are acceptable.

#### Organization

Receiving functions are typically assigned to a department other than Quality Control (QC) except that QC may retain certain responsibilities for exercising acceptance decisions. While departmental titles vary among companies, the department assigned responsibility for receiving is considered the Material Services Department herein. Material Services is a support organization responsible for receiving of items, and storage of items not immediately needed by other

departments. Where advance planning has identified what items will be needed and the schedule for their use, Material Services may also initiate procurement of the items. For example, Material Services for the Operations Phase may be responsible for controlling repair part inventory such that as items reach minimum stock inventory level, purchases are made to increase inventory. Finally, Material Services may perform certain inspections of received items.

The Quality Assurance Department (QA) is typically responsible for ensuring that Materials Services uses documented procedures which comply with the quality assurance program. In this regard, QA ensures that acceptable practices are used for receipt, handling, storage, and issue of received items. QA also typically designates the extent of inspection to be performed as an integral part of receiving.

The Quality Control Department (QC) performs receiving inspection consistent with assigned responsibility. For items subject to QC inspection, QC establishes and implements inspection procedures using trained inspectors.

### Facilities

The receiving activity requires facilities for the receipt, handling, storage, and issue of items. Items are initially received at truck and/or train off-loading docks and initial lay-down areas. Lifting equipment can include fork-lift trucks, other types of mobile equipment, chain falls, cranes, hoists, elevators, and associated cables, hooks, clamps, and beams. Initial lay-down areas are typically paved or provided with timbers to keep received items off the ground. Such areas are designed to avoid standing water. Items to be stored outside are offloaded at their outside storage area if possible. Items are moved to inside storage, or if necessary, to outside storage by equipment designed for the purpose. Fork lift trucks are



typically used for smaller items and cranes or "cherry pickers" are typically used for larger items. Storage facilities are designed to provide necessary protection which is dependent upon the susceptibility of the item to deterioration in storage. Such facilities can range from outside skids to enclosed, environmentally controlled rooms. Equipment used to transport items from storage to their point of use is typically the same or similar to the equipment which placed the items into storage.

### Levels of Packaging

Items are packaged by suppliers to afford protection in transit. The extent of packaging is specified by the purchaser, typically by referencing a national standard which describes packaging levels. The purchaser also requires suppliers to identify any special storage requirements which are necessary to prevent or minimize deterioration in storage. Generally, packaging and storage requirements are similar except that packaging must also prevent damage from movement of items in transit.

Four levels of requirements for packaging nuclear components are defined: Level A, B, C, and D. Each level prescribes packaging requirements that protect the component during shipping, handling and storage. The specific level applied is dependent on the conditions demanded of the component by the system that uses the component. This means that the level of packaging that is selected must protect and preserve those features of the component that exist to meet the requirements that are demanded of the component by the plant system. Examples of such requirements include cleanliness, freedom from oxidation, freedom from nicks and gouges, protection of weld preparation dimensions, and protection of electrical circuits.

Components classified as needing Level A packaging are those that require extraordinary environmental protection. Level A packaging affords protection from (1) shock and vibration, (2) temperature and humidity extremes, and (3) foreign materials such as dirt, sand, oil, water, etc.

Components classified as needing Level B packaging are those that are sensitive to environmental conditions but not to the extreme as Level A. The packaging for Level B components requires the same degree of protection as Level A except control of temperature and humidity extremes is not required.

Level C components require protection from the environment and airborne containments but not from water vapor and condensation to the degree which is applicable for Level A and Level B components.

The lowest level of packaging requirements is Level D. Level D components are the least sensitive to environmental conditions. Protection against weather conditions and physical damage is required for Level D components.

The component supplier performs final inspections prior to packaging to insure the component is ready for packaging. These inspections determine cleanliness; freedom from entrapped water, dirt, residue, metal chips, and any other form of contamination; proper assembly; and correct dimensions. The component is then packaged to meet the specified level of protection. Types of packaging are summarized as follows:

- Protection from temperature and humidity extremes -  
The primary purpose of this protection is to prevent condensation from collecting on the component. Protection from condensation is afforded by vapor proof barriers or by capping all openings of the components. Dessicants (moisture absorbing agents) may also be placed inside the barrier. Vapor barrier

material is sealable. The section of the barrier which can be opened for access to the component must be large enough to permit at least two subsequent sealing operations.

- Protection from weather and foreign materials - The component is wrapped with a second barrier to protect it from salt, dust, and other forms of contamination. Each barrier is a flexible material designed to withstand the penetration of water, water vapor, grease, etc. Barriers are constructed of materials which are not easily damaged by puncture, abrasion, weathering, cracking due to temperature extremes, and wind conditions. When used for stainless steel components, the barrier material must not contain halogens (any of the five elements: fluorine, chlorine, bromine, iodine, and astatine). Halogens can cause stress corrosion cracking in stainless steels. Also, barrier material must not be corrosive and must not readily support combustion. Component openings are capped, plugged, or sealed. Weld end preparations are also protected against physical damage. For Level A components, these protective devices are needed in addition to the flexible barriers. For other levels, these devices may substitute for the flexible barrier. Caps and plugs are colored differently than the component so that they can be easily located if they are pushed into the component. An exception to this rule is the use of clear, plastic closures as a window for humidity indicator cards. Metallic caps and plugs are made of a material compatible with the component in order to avoid galvanic corrosion. Gasketing or other nonmetallic materials used for sealing must not have a corrosive effect on the component.

- Protection from shock and vibration - Components may be placed into containers or blocked on open skids. They are anchored, braced and cushioned to prevent motion of the component independent of the container or skid.

## RECEIVING INSPECTION ATTRIBUTES

### Types

Several types of attributes are subject to receiving inspection. The specific attributes for given items can generally be grouped by three types. These are attributes pertaining to (1) shipping damage, (2) identity and quantity, and (3) function. Receiving inspection typically addresses at least the first two types as a minimum.

### Inspection Attributes for Shipping Damage

Items are shipped by a variety of modes. Truck, rail, air, and barge transportation are all used dependent on the item. Damage can occur in transit from shock, vibration, mishandling, and from environmental conditions. One objective of receiving inspection is to determine if damage has occurred to items received.

The condition of packaging is indicative of the condition of received items although not exclusively so. Accordingly, the condition of packaging is examined for evidence of damage. If packaging is damaged, the item may or may not be damaged. But, if packaging is damaged, detailed examination of the item is in order.

Packaging is considered in two broad categories: open and boxed. Open packaging consists of tie-downs between the item and skids, pallets, or the beds of trucks, railcars, or barges. Braces, pads, plugs, and other protective devices

are used as necessary. Attributes of open packaging which are of concern include loose tie-downs, missing pads and plugs, bent ties and braces, and evidence of shifting between the item and its supports. With respect to boxed or crated items, attributes of concern include crushed or torn areas, splintered or broken crating, and split or cracked containers.

Environmental damage can occur with either open or boxed packaging. Attributes of concern include rust, oil stains, water marks, salt films, and other stains or films. Also, included in this category is evidence of fire such as charred wood, paint or paper.

Attributes of the item itself which are of concern with respect to damage include those pertaining to integrity of extensions and members and surface condition. Broken, bent, deformed, cracked, or crushed areas are most likely on extensions, fragile members, and areas of perturbation from the general shape of the item. Attributes of surface condition include dents, gouges, scratches, and detrimental films or residues. Salts and other residues may be corrosive to the item. Oil and other contaminants may cause deterioration of function or simply require cleaning before use of the item. Some items, such as chemicals, can be rendered totally useless by environmental contamination.

#### Inspection Attributes for Identity and Quantity

Identification of items is provided by either identification on the item or paperwork accompanying the item, or both. The extent of identification is dependent on the requirements of the purchase order for the item.

Identification on the item consists of either nameplates, markings, or tags. For materials, attributes of concern include type, condition, heat, and possibly size. *Type* refers to the specific alloy or compound. *Condition* refers to the



heat treatment and/or finished condition. *Heat* refers to the melt of metallic alloys. A similar term is *lot* which refers to a grouping by finished condition or by batching operations. For components and parts, attributes of concern include type, kind, and rating. *Type* refers to the general category of components such as valve, pump, pressure vessel, pipe, etc. *Kind* refers to the specific variety within the category such as gate valve, globe valve, check valve, etc. *Rating* refers to further characterization of the item which correlates it with the purchase order. For electrical items, ratings include such characteristics as power, voltage, For mechanical items, ratings include such characteristics as pressure, head, flow, speed, etc.

Components and parts are frequently identified by a unique number as well as by the foregoing. Model number or part number uniquely identifies the type and kind. Such numbers are not to be confused with serial numbers or lot control markings. When serialization is required by procurement documents, each item of the same type and kind is also assigned a unique serial number. The serial number permits traceability from a given item to all records supporting the quality of the item. Lot control marking permits limited traceability to a period of time or to a specific batch relating to the manufacture of the item.

Paperwork which accompanies the item typically identifies the item and attests to its quality. The exact paperwork required to accompany the item is specified by procurement documents. When nothing is specified, suppliers merely provide their "shipper", or "shipping invoice". The *shipper* is a supplier document which identifies the supplier, the receiving address, and the item nomenclature and quantity. The shipping invoice is an unpriced copy of the supplier's invoice for payment which serves as the *shipper*. The shipping invoice provides the same information as the *shipper*. Neither of these documents attests to item quality.

Other accompanying documents which may be required by the purchase order are generally of these types: material test report, data reports, and certification of compliance. These documents both identify the item and attest to quality of the item. None of these documents are required unless specified by procurement documents.

Material test reports identify for each heat or lot the material properties of the item. The item's chemistry and mechanical strength are typically required to be reported. The report must identify the item represented and give actual values resulting from chemical analysis and mechanical tests. The format of the report is left to the supplier's discretion. An example material test report is illustrated in Figure 31-3-1. The example illustrates a report for nickel-chrome-iron tubing. The example report and the tubing it represents are correlated by the heat number and size.

Data reports provide results of inspections and tests performed by the supplier. Certain codes and standards specify the format of data reports. Otherwise the format of the data report is left to the discretion of the supplier. A sample data report for a six inch gate valve to the ASME Boiler and Pressure Vessel Code is illustrated in Figure 31-3-2. As indicated by the sample report, the data report is correlated to the valve by serial number.

Certificates of conformance are signed statements of compliance with procurement documents without any further supporting evidence. Such statements are signed by senior supplier management and certify that acceptable items are being supplied.

XYZ Company  
Washington, D.C.

Item: 5/8" Tubing Condition: Hot-Finished- Annealed  
Specification: ASTM SB-167 Heat: XL103B

| Chemistry       |          |           |          |         |          |         |         |           |
|-----------------|----------|-----------|----------|---------|----------|---------|---------|-----------|
| Element<br>Test | Ni       | Cr        | Fe       | Mn      | C        | Cu      | Si      | S         |
| Specified       | 72.0 min | 14.0-17.0 | 6.0-10.0 | 1.0 max | 0.15 max | 0.5 max | 0.5 max | 0.015 max |
| Heat Analysis   | 74.5     | 15.5      | 9.0      | 0.8     | 0.05     | 0.05    | 0.2     | 0.005     |

| Mechanical Properties |            |            |            |
|-----------------------|------------|------------|------------|
| Property<br>Test      | Tensile    | Yield      | Elongation |
| Specified             | 80,000 min | 30,000 min | 35% min    |
| Specimen #1           | 88,000     | 34,500     | 38%        |
| Specimen #2           | 87,000     | 34,000     | 39%        |

Hydrostatic Test: 1500 Psig satisfactory

The items reported herein are certified as complete and accurate results of testing of the identified heat.

Figure 31-3-1. Sample Material Test Report

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FORM NPV-1 N CERTIFICATE HOLDERS' DATA REPORT FOR NUCLEAR PUMPS OR VALVES\*  
As Required by the Provisions of the ASME Code, Section III, Div. 1

1. Manufactured by XYZ Co., Main Street, Anytown, USA  
(Name and Address of N Certificate Holder)

2. Manufactured for ABC Power Company  
(Name and Address of Purchaser or Owner)

3. Location of Installation ABC Power Company, Main Street, Anytown, USA  
(Name and Address)

4. Pump or Valve Valve Nominal Inlet Size 6" Outlet Size 6"  
(Inch) (Inch)

(a) Model No. (b) N Certificate Holder's (c) Canadian  
Serial No. Registration No. (d) Drawing No. (e) Class (f) Nat'l (g) Year  
or Type No. No. No. No. No. No. No.

11. 5247 WE HP C59001 N/A A-9876-M-2B 1 500 1977

12. \_\_\_\_\_

13. \_\_\_\_\_

14. \_\_\_\_\_

15. \_\_\_\_\_

16. \_\_\_\_\_

17. \_\_\_\_\_

18. \_\_\_\_\_

19. \_\_\_\_\_

20. \_\_\_\_\_

5. Feedwater Isolation Valve  
(Brief description of service for which designed and intended)

6. Design Conditions 1785 ps. 300 or Valve Pressure Class \_\_\_\_\_ (1)

7. Cold Working Pressure 2160 ps. or 100 \_\_\_\_\_

8. Pressure Retaining Pieces

| Part No.          | Material     | Manufacturer | Remarks           |
|-------------------|--------------|--------------|-------------------|
| (a) Castings      |              |              |                   |
| Body A0389-1      | SA-351, CF8M | XYZ Co.      | Seal Welded Seats |
| Bonnet A0490-1    | SA-351, CF8M | XYZ Co.      | CoCrA Backseat    |
| Wedge A0391-1     | SA-351, CF8M | XYZ Co.      | CoCrA Faced       |
| Seat Ring A0392-1 | SA-351, CF8M | XYZ Co.      | CoCrA Faced       |
| Seat Ring A0392-2 | SA-351, CF8M | XYZ Co.      | CoCrA Faced       |
| Ret. Ring A489F   | SA-216, WC   | XYZ Co.      |                   |
|                   |              |              |                   |
|                   |              |              |                   |
| (b) Forgings      |              |              |                   |
|                   |              |              |                   |
|                   |              |              |                   |
|                   |              |              |                   |
|                   |              |              |                   |
|                   |              |              |                   |
|                   |              |              |                   |
|                   |              |              |                   |
|                   |              |              |                   |
|                   |              |              |                   |

(1) For manually operated valve only

\* Supplemental sheets in form of lists, sketches or drawings may be used provided (1) size is 8-1/2" x 11", (2) information in items 1, 2 and 5 on this Data Report is included on each sheet, and (3) each sheet is numbered and number of sheets is recorded at top of this form

This form may be obtained from the Order Dept., 345 E 47th St., New York, N.Y. 10017

Figure 31-3-2. Form NPV-1 Manufacturer's Data Report for Nuclear Pumps or Valves





### Inspection Attributes for Item Function

The function of items cannot easily be determined at receiving. To truly check function of items, test apparatus would have to simulate the operating parameters and environment and measure the item's performance under such conditions. Such testing is rarely done at receiving. Instead, receiving inspection determines if evidence of deterioration of functionality exists. Such evidence typically consists of physical damage, lack of cleanness, missing parts, and insufficient fluids such as lubricating oil. Attributes pertaining to damage were previously described.

Cleanness of items includes the attributes of rust, scale, films, dirt, oil, grease, chips, and any other foreign matter prohibited or limited by procurement documents. The acceptance criteria for cleanness are given by procurement documents as either prohibition or limitations. Loose foreign materials are typically prohibited in the internals of the item. Oxides are typically limited although they may be prohibited for certain specialized items. An example of a limitation is "only tightly adherent oxide films which are not removed by hand wire brushing". Cleanness of the item can interfere with the function of the item and is, therefore, typically checked at receiving.

The missing parts category includes a wide variety of possibilities. Experience indicates that most frequent occurrence of missing parts pertains to (1) unassembled parts which are required to accompany the partially assembled item and (2) hardware associated with fasteners in the assembled item. Some items are delivered as partial assemblies with attached parts necessary to complete the assembly. Also, sometimes parts needed at installation of the item into a system are required to be attached to the item. Accompanying parts typically fall into the categories of

fasteners, mounts, couplings, connectors, brackets, cabling, hoses, covers, and safety guards. Hardware associated with fasteners in the assembled item include bolts, screens, flat washers, lock washers, nuts, and locking devices such as lock wires, lock tabs, and lock cups. While experience indicates that the foregoing are most frequent culprits, the concept of missing parts actually includes anything required by procurement documents which does not exist in or with the received item.

Procurement documents may require items to be filled or coated with specified fluids. Examples of operating fluids attributes include grease cups, grease fittings, and oil reservoirs. Protective coatings include oil, grease, paint, and gas blankets such as nitrogen. Whenever required by procurement documents, attributes pertaining to fluids and coatings are made subject to receiving inspection.

## RECEIVING INSPECTION PRACTICES

### Levels of Inspection

The extent of inspection performed at receiving is dependent on the importance of the item to plant operation and whether inspection was performed by representatives of the purchaser at the source of fabrication of the item. Dependent on these factors, various levels or degrees of inspection are established by the QA Department. The exact inspection levels used vary somewhat among purchasers. Nonetheless, four basic levels are typically used. These are (1) visual examination for identity and lack of damage, (2) record review of supplier reports, (3) visual examination for item conformance with procurement documents, and (4) inspection of specified product attributes.

Visual examination for identity and lack of damage is typically performed by the Material Services Department for all items upon their receipt. Where possible, this examination is performed prior to off-loading of items in order to avoid accepting custody of items if they are damaged or of incorrect kind. Material Services receiving technicians examine for identity by comparing purchase order requirements with the identification on the item evidenced by nameplate, marking, labels, or tags. The technician verifies that the type, kind, rating, and quantity agree with procurement documents. The technician examines for damage by visually inspecting the packaging and, for unsealed items, inspecting the item. Where evidence of potential damage exists, the technician is typically required to notify a QC inspector who then performs a thorough examination. Deficiencies found in identity are also reported to the QC inspector who documents the deficiencies.

Record review of supplier documents is typically performed by the QC inspector. The Materials Services technician checks for the existence of supplier documentation as part of the identity checks. If required documentation is not with the item, the technician notifies the QC inspector who documents the deficiency. The technician forwards the supplier documents to the QC inspector for review. The inspector compares requirements of procurement documents against the vendor reported data.

Visual examination for conformance of items with procurement documents is typically performed by the QC inspector and only for designated items. Those items most important to safe plant operation are designated as requiring this inspection. Such designation is typically by a "Q" list which identifies all items which will be received and

whether inspection for conformance applies. For such items, the QC inspector compares drawing requirements with the item to determine compliance. Such visual examination determines if the item "looks like" the drawing. Checks include orientation, size, shape envelope, surface condition, cleanliness, existence of features such as bolt holes, slots and keyways, and lack of damage. Sealed items are typically unsealed to permit this inspection and then resealed. An exception is where exposure to atmosphere must be avoided. In such cases, inspection is performed visually through the sealing material if transparent or delayed until installation if opaque.

Inspection of specified product attributes is typically performed by the QC inspector and only for designated items. Product attributes made subject to this inspection are typically those which interface with other items at installation. Examples include weld end preparations, flange faces and holes, threaded connections, seating surfaces, and electrical characteristics, functions and connections. For these attributes, the QC inspector uses appropriate measuring and test equipment to inspect the item. Such measuring devices must be calibrated. Items made subject to this level of inspection are typically only those of great importance to safe plant operation.

#### Receiving Inspection Records

Receiving inspection begins with receipt of items and ends with release of accepted items to stores or identification of nonconforming items for disposition. As previously described, the Material Services technician receipt inspects everything for identification and lack of damage. For nonconforming items and for items requiring QC inspection, the technician notifies the QC inspector. Upon being notified, the QC Inspector verifies nonconformance and/or



performs additional planned inspections. Thus, records are usually generated by the receiving technician or by the inspector for those items requiring QC inspection.

The Material Services technician typically records his/her inspection results either on a copy of the purchase order or on the supplier's shipper. Where a copy of the purchase order is used, a preprinted section is often provided across the bottom of the purchase order form. This section requires entries of (1) quantity ordered, (2) quantity received, (3) quantity accepted, and (4) date of receipt. Where preprinted sections are not provided and where shippers serve as the record, an ink stamp is often used to stamp the document with a single format which requires the same four entries. The completed record is typically forwarded to Purchasing Department as evidence that payment to the supplier can be initiated. A separate stock inventory record is typically prepared to identify that items are available for use as needed. During the Construction Phase, a copy of the stock inventory record is typically forwarded to the Planning Section responsible for scheduling construction activities. During the Operations Phase, the stock inventory record is used by Material Services to maintain status of inventory levels.

For items subject to QC inspection, a QC inspection report is also generated. A sample QC inspection report is illustrated in Figure 31-3-3. This sample report is based on the QC inspector determining the exact attributes to be inspected using the form as a guide. For each attribute on the form, the inspector determines from the procurement document if specific requirements apply. Where specific requirements are specified, the inspector examines corresponding attributes. Otherwise, the attributes on the form are marked N.A. (not applicable). Other types of forms are used in conjunction with receiving inspection procedures



which specify exactly what is to be inspected. A third type is a form where an engineer enters the attributes to be inspected and the inspector enters the inspection results. All such forms provide space for recording (1) item identity, (2) attributes inspected, (3) acceptance of the item and (4) nonconformance report number for rejected items.

Items accepted by receiving inspection are typically tagged to positively identify the acceptance status. Green tags are often used of a format similar to that in Figure 31-3-4. The tag is physically attached to the item and not removed until installation of the item into its system.

Items rejected by receiving inspection must be identified as nonconforming to prevent their inadvertant use. Typically, red tags are used of a format similar to that illustrated in Figure 31-3-5. The tag is physically attached to the item and not removed until disposition of the nonconformance. The disposition may be (1) accept-as-is, (2) repair, (3) rework, or (4) replace dependent on the specific nonconformance.

Red tags are removed (after disposition) only by the originator or by the QA inspector.

## QUALITY CONTROL RECEIVING INSPECTION REPORT

DATE OF Q.C. INSPECTION \_\_\_\_\_

|                        |  |  |  |                    |  |  |  |                          |  |  |  |
|------------------------|--|--|--|--------------------|--|--|--|--------------------------|--|--|--|
| SYSTEM NO./NAME        |  |  |  | PURCHASE ORDER NO. |  |  |  | DATE                     |  |  |  |
| COMPONENT/PART NO.     |  |  |  | VENDOR             |  |  |  |                          |  |  |  |
| SERIAL NO./MODEL NO.   |  |  |  | SPECIFICATION NO.  |  |  |  |                          |  |  |  |
| HEAT NO./LOT NO.       |  |  |  |                    |  |  |  |                          |  |  |  |
| DWG. NO./PART NO.      |  |  |  | CODE CLASS         |  |  |  |                          |  |  |  |
| Assigned Storage Level |  |  |  |                    |  |  |  | Nonconformity Report No. |  |  |  |
| A. Special Environment |  |  |  |                    |  |  |  | Disposition              |  |  |  |
| B. Inside Heated       |  |  |  |                    |  |  |  | Accept                   |  |  |  |
| C. INSIDE              |  |  |  |                    |  |  |  | Hold                     |  |  |  |
| D. OUTSIDE             |  |  |  |                    |  |  |  | Reject                   |  |  |  |
|                        |  |  |  |                    |  |  |  | Tag #                    |  |  |  |
|                        |  |  |  |                    |  |  |  | Tag #                    |  |  |  |

| QWC NO.<br>OR P.O. | ITEM | QTY. | DESCRIPTION(S) AND INSPECTION REMARK(S) |  |      |         |      |         |  |  |  |  |
|--------------------|------|------|-----------------------------------------|--|------|---------|------|---------|--|--|--|--|
|                    |      |      | ITEM INFORMATION                        |  | SAT. | UN-SAT. | N.A. | REMARKS |  |  |  |  |
|                    |      |      | Identification and Marking              |  |      |         |      |         |  |  |  |  |
|                    |      |      | Manufacturing Documentation             |  |      |         |      |         |  |  |  |  |
|                    |      |      | Protective Covers and Seals             |  |      |         |      |         |  |  |  |  |
|                    |      |      | Coatings and Preservatives              |  |      |         |      |         |  |  |  |  |
|                    |      |      | Paint or Plaster                        |  |      |         |      |         |  |  |  |  |
|                    |      |      | Corrosion                               |  |      |         |      |         |  |  |  |  |
|                    |      |      | Structural Damage                       |  |      |         |      |         |  |  |  |  |
|                    |      |      | Leakage                                 |  |      |         |      |         |  |  |  |  |
|                    |      |      | SOUND, VIBR., THERM. VLS. MEAS.         |  |      |         |      |         |  |  |  |  |
|                    |      |      | If Not Perform the following List:      |  |      |         |      |         |  |  |  |  |
|                    |      |      | Physical Properties                     |  |      |         |      |         |  |  |  |  |
|                    |      |      | Dimensions                              |  |      |         |      |         |  |  |  |  |
|                    |      |      | Weld Preparations                       |  |      |         |      |         |  |  |  |  |
|                    |      |      | Workmanship                             |  |      |         |      |         |  |  |  |  |
|                    |      |      | Defects and Flaws                       |  |      |         |      |         |  |  |  |  |
|                    |      |      | Electrical Insulation                   |  |      |         |      |         |  |  |  |  |
|                    |      |      | Special Inspection                      |  |      |         |      |         |  |  |  |  |
|                    |      |      | SIGHT                                   |  |      |         |      |         |  |  |  |  |
|                    |      |      | INSTRUMENTS                             |  |      |         |      |         |  |  |  |  |
|                    |      |      | RECORD                                  |  |      |         |      |         |  |  |  |  |
|                    |      |      | X-RECORDS REQUIRED                      |  |      |         |      |         |  |  |  |  |
|                    |      |      | X-RECORDS NOT REQUIRED                  |  |      |         |      |         |  |  |  |  |
|                    |      |      | SPOT                                    |  |      |         |      |         |  |  |  |  |
|                    |      |      | CHECK                                   |  |      |         |      |         |  |  |  |  |

|      |  |  |  |      |  |  |  |
|------|--|--|--|------|--|--|--|
| DATE |  |  |  | PAGE |  |  |  |
|------|--|--|--|------|--|--|--|

Figure 31-3-3. Sample QC Receiving Inspection Record

Figure 31-3-5 shows two examples of nonconformance tags. The top tag is a red tag with a hole on the left and the text "TAG NO." followed by a line, "HOLD FOR Q.C. RELEASE", and "MAY NOT BE REMOVED WITHOUT AUTHORIZATION". The bottom tag is a white tag with a hole on the left and a form with various fields for inspection details.

Figure 31-3-5. Example Nonconformance Tag (Typically Red)

Figure 31-3-4 shows a sample acceptance tag, typically green, with a hole on the left and the text "MATERIAL CONFORMANCE" at the top. Below this, there are several horizontal lines and a large "Q.A." in the center.

Figure 31-3-4. Sample Acceptance Tag (Typically Green)

## HANDLING DURING RECEIVING INSPECTION

### General

Handling requirements are specified to minimize the possibility of damaging items during positioning and transporting of items. The extent of handling requirements depends on the specific item and the equipment necessary to position or transport the item. QC receiving inspection must use proper handling techniques during inspections and are sometimes responsible for observing the handling practices of others for compliance to requirements.

Detailed handling instructions are prepared for those components which require special handling because of weight, size, susceptibility to shock damage, high nil ductility transition temperatures, or any other conditions that warrant special instructions. These instructions are made available to the inspector prior to the time the component is to be handled. The procedure indicates the weights, sling locations, balance points, methods of attachment, maximum hoist line speeds, and any other pertinent features to be considered as necessary for safe handling.

Hoisting equipment used for handling components are certified by the manufacturer. The certification indicates the various parameters for the maximum load to be handled by the equipment. Hoisting equipment must not be loaded beyond its rated load, as certified by the manufacturer, except for test purposes. For special lifts, hoisting equipment may be re-rated, or modified and re-rated, upon approval by the manufacturer. If the manufacturer's specifications are not available, the limitations assigned to the equipment must be based on the determinations of a qualified engineer competent in this field. This determination must be documented and recorded appropriately.

Re-rated equipment must be given a dynamic load test over the full range of lift using a test weight at least equal to 110% of the lift weight. A dynamic test includes raising, lowering, and traversing the load in contrast to a static test where the test weight may be increased incrementally with no movement.

During handling activities, the inspector typically verifies the following:

- Rigging is not frayed, worn or otherwise deteriorated.
- Hoisting equipment ratings are equal to or greater than the load.
- Equipment and rigging is clean and free of contaminants that are detrimental to the item being handled.
- Rigging items such as hooks, shackles and turn buckles have not yielded, distorted, or deformed.
- Load measuring devices such as strain gages or pressure gages are used when specified.
- Rapid movement or jerking is avoided.
- Lifting lugs or other appropriate loading surfaces on the item are used.
- Ample space exists for the movement or transporting.





## EXERCISES

The following exercises serve to reinforce the information presented in this module.

1. Complete Table 31-3-1 given in the Data Table section of this module by filling in the typical attributes of *shipping damage, identity and function*. Use the information presented in this module as guidance.
2. Name and briefly describe the four levels of receiving inspection by completing Table 31-3-2 in the Data Table section of this module. Use the information on the Levels of Receiving Inspection presented in this module for guidance.
3. Review a sample material test report against the corresponding material specification. Document your results as outlined in the Procedures section of this module.
4. Review a receiving inspection record and prepare a narrative report on strengths and weaknesses of the record. Consider item identification, inspection attributes, acceptability, and nonconformance.
5. Inspect a packaged item supplied by the inspector. Prepare a record similar to that illustrated in Figure 31-3-3 of this module and document results thereon.
6. Inspect a defective item, i.e. one not in compliance with the purchasing requirements, and prepare a Quality Control Receiving Inspection Report, proper tag and Nonconformance form.



## MATERIALS

The following materials are required to support this module:

- Receiving inspection procedures for packaged items.
- Sample material test report and corresponding material specifications.
- Sample receiving inspection records.



## PROCEDURES

1. Review a sample material test report against the corresponding material specifications as requested in exercise 3 of this module.

Using Table 31-3-3 given in the Data Table section of this module, list the following:

a. Chemical Analysis:

- (1) Required Chemical Specifications
- (2) Actual Chemical Analysis

b. Mechanical Properties:

- (1) Type of Mechanical Test performed
- (2) The required value for the test performed
- (3) The reported value for the test performed



# DATA TABLE

1. Table 31-3-1 refers to exercise 1 of this module.

Table 31-3-1  
Receiving Inspection Attributes

| Applicable To   | Typical Attributes |
|-----------------|--------------------|
| Shipping Damage |                    |
| Identity        |                    |
| Function        |                    |

2. Table 31-3-2 refers to exercise 2 of this module.

Table 31-3-2  
Levels of Receiving Inspection

| Level Title | Description |
|-------------|-------------|
| 1.          |             |
| 2.          |             |
| 3.          |             |
| 4.          |             |

3. Table 31-3-3 refers to exercise 3 of this module.

Table 31-3-3  
Review of Material Test Report

Specification: \_\_\_\_\_  
Item Identity: Type \_\_\_\_\_ Size \_\_\_\_\_  
Model \_\_\_\_\_ Serial \_\_\_\_\_  
Heat or Lot \_\_\_\_\_

Chemistry:

| Element<br>Test   |  |  |  |  |  |  |  |  |
|-------------------|--|--|--|--|--|--|--|--|
| Required<br>Value |  |  |  |  |  |  |  |  |
| Reported<br>Value |  |  |  |  |  |  |  |  |

Mechanical Properties:

| Type Test | Required Value | Reported Value |
|-----------|----------------|----------------|
|           |                |                |
|           |                |                |
|           |                |                |
|           |                |                |
|           |                |                |





## REFERENCE MATERIALS

Juran, J.M., Quality Control Handbook, 1974, McGraw-Hill, Inc.

ASME, Quality Assurance Program Requirements for Nuclear Power Plants, ANSI N45.2, The American Society of Mechanical Engineers

ASME, Quality Assurance Requirements for Control of Procurement of Items and Services for Nuclear Power Plants, ANSI N45.2.13, The American Society of Mechanical Engineers

ASME, Packaging, Shipping, Receiving, Storage, and Handling of Items for Nuclear Power Plants, ANSI N45.2.2, The American Society of Mechanical Engineers

ANS, Administrative Controls and Quality Assurance for the Operational Phase of Nuclear Power Plants, ANS 3.2/ANSI 18.7, American Nuclear Society



1. Name three functions typically accomplished by the receiving activity.
  - a.
  - b.
  - c.
2. Describe the relative responsibilities for the receiving activity of Material Services Department, Quality Assurance Department, and Quality Control Department.
  - a. Material Services
  - b. Quality Assurance
  - c. Quality Control
3. A thirty-six inch motor operated gate valve is received which is strapped to a shipping pallet. Describe inspection for shipping damage including attributes associated with this inspection.
4. A dozen relays are received with each in a cardboard box and the twelve boxes in a larger cardboard box. The large box has oil stains across the bottom and one upper corner is crushed. Describe inspection for shipping damage.

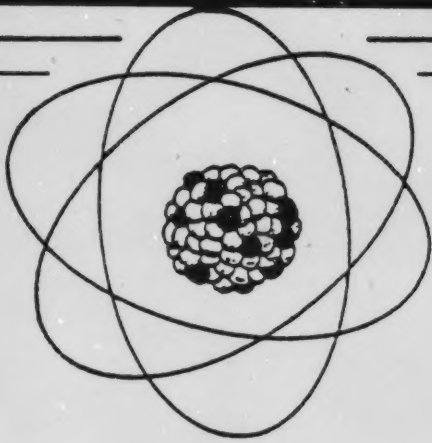
5. Describe receiving inspection for identity including typical attributes associated with this inspection.
6. Name two types of paperwork which may accompany received items and which attests to quality of the items.
7. For each of the documents named in question #6, describe the general content of the document.
8. Describe receiving inspection of items for function-ability of the item including typical attributes associated with this inspection.
9. Name three levels of receiving inspection and briefly describe each.

10. Describe the uses of:

a. QC Receiving Inspection Report

b. Conformance Tag

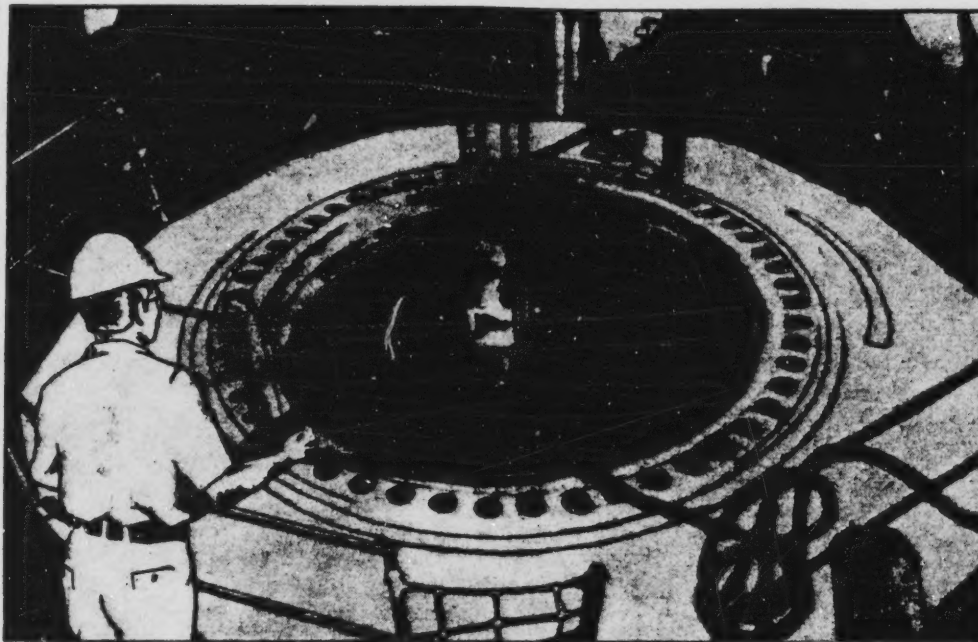
c. Nonconformance Tag



# NUCLEAR TECHNOLOGY

## MODULE 31-4

IDENTIFICATION, STORAGE AND HANDLING OF COMPONENTS,  
PARTS AND MATERIALS



## COURSE 31 QUALITY ASSURANCE PRACTICES



CENTER FOR OCCUPATIONAL RESEARCH AND DEVELOPMENT

4800 LAKEWOOD DRIVE WACO, TEXAS





## COURSE MODULES

### COURSE 31 QUALITY ASSURANCE PRACTICES

|                                                                                               |                                                                         |
|-----------------------------------------------------------------------------------------------|-------------------------------------------------------------------------|
| MODULE 31-1                                                                                   | Overall Quality Assurance Program                                       |
| MODULE 31-2                                                                                   | Vendor Qualification                                                    |
| MODULE 31-3                                                                                   | Receiving Inspection                                                    |
|  MODULE 31-4 | Identification, Storage and Handling of Components, Parts and Materials |
| MODULE 31-5                                                                                   | Non-Conforming Materials                                                |
| MODULE 31-6                                                                                   | Certification and Qualification of Quality Control Inspectors           |
| MODULE 31-7                                                                                   | Auditing for Quality Assurance                                          |
| MODULE 31-8                                                                                   | Document Handling, Storage and Retrieval for Quality Assurance          |

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## INTRODUCTION

The Nuclear QA/QC Technician may be assigned responsibilities for periodically inspecting the identification, storage, and handling of items at the nuclear power plant site. These inspections are performed in accordance with written procedures which identify the types of observation and the acceptance criteria. Knowledge of identification, storage, and handling practices is necessary to accomplish these inspections.

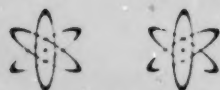
This module describes the activities of identification, packaging, handling, and storage. The identification methods are described and required types of information are listed. The protective measures associated with packaging, shipping, receiving, handling and storage are described. The rationale for levels of protection is given and key features of each level are described.

This module concludes by describing the inspections associated with handling and storage activities. Inspection attributes and methods are described. Receiving inspection is beyond the scope of this module.



## MODULE PREREQUISITES

The three previous modules of this course should be completed before proceeding to this module.



## OBJECTIVES

Upon completion of this module, the student/trainee can:

1. Describe any of seven identification methods when given the name of the method.
2. State the purpose of protective measures during the activities of shipping, receiving, storage, and handling.
3. Describe the product characteristics considered in categorizing product as requiring levels A, B, C and D protection.
4. Describe the protection afforded by the following packaging features:
  - a. barriers
  - b. dessicants
  - c. caps and plugs
  - d. containers
  - e. inert gas blanket
  - f. contact preservative
  - g. blocks, braces, and cushions
5. Describe the identification of containers used for shipping or storage of items including at least five types of information required of such identification.
6. Briefly describe storage conditions for protection levels A, B, C, and D.
7. Briefly describe the inspection of storage conditions with respect to:
  - a. identification
  - b. covers, plugs and seals
  - c. dissicants
  - d. inert gas blankets
  - e. physical condition
  - f. cleanness

8. Briefly describe the inspection of handling equipment with respect to:
  - a. visual inspections
  - b. nondestructive examination
  - c. load tests
9. Perform inspections of storage conditions.



## NOTES TO INSTRUCTOR / STUDENT

The Procedures of this module require inspection of packaged items. To perform these procedures, packaged items received by your institution for any purpose may be used. Also, storage rooms may be inspected as described by this module.



# SUBJECT MATTER

## PRODUCT IDENTIFICATION

### Source of Requirements

Equipment, components, parts, and materials used in the construction and maintenance of nuclear power plants are required to meet codes and standards that are made mandatory by federal, state, and local regulations and by specific design of the plant. Identity of these items is required to provide positive evidence of exactly what items are on-hand and used. Such identity is required to be on or attached to the item either permanently or until installation is documented.

The specific identification required is dependent on the technical code, standard, specification, and/or drawing which characterizes the design of the item. Typically, design drawings specify the required identification by either stipulating such identification or by referencing the technical document which contains identification requirements. In either case, the method of identification and the amount of identification is specified

### Types of Identification Methods

The exact identification method for a given item is specified by the technical document which characterizes the design of that item. Therefore, only a survey of popular methods is possible within this module. QA/QC technicians on the job would refer to the governing technical document to determine the identification method for a given item.

Identification methods include (1) nameplate, (2) stamping, (3) marking, (4) casting or molding, (5) labeling (6) tagging, and (7) vibra-tool. The method used must be permanent unless otherwise specified and it must not be deleterious to the function of the item. Each method



typically requires the amount of identification to include (1) manufacturer, (2) item nomenclature, (3) model, heat, or lot number, (4) serial number, if serialization is required, and (5) ratings such as pressure, electrical ratings, speed, etc. The governing technical document specifies the minimum required identification.

Nameplates are commonly used for identification of equipment and components. For example, nameplates are used for pressure vessels, pumps, valves, generators, motors, turbines, switchgear, control panels, pressure transmitters, etc. Entries on nameplates are typically made by chemical etching or die stamping. In either case, entries are typically made prior to attaching the nameplate to the item for reasons of practicality and avoidance of damage to the item. Nameplates are attached by tack welding or threaded fastener or both.

Stamping is often used for applying identification to metallic alloys in the melt, semi-finished, and finished stages. Examples include ingots and billets supplied by a material melter, wrought product, forgings, and rolled product. However, another method is used if stamping interferes with the junction of these items and, therefore, is not always used, especially for rolled products. Stamping is used for some parts and components although restrictions typically apply. Welders of ASME pressure retaining items are required to use identification stamps for weld traceability.

Stamping is accomplished by die-stamps which are struck against the item. Low stress die stamps which have a liberal radius on the characters are typically required in order to avoid creation of sharp notches which localize stresses in service. Stamping is applied to non-working surfaces to avoid interference with function. Where subsequent processing removes the stamped identification, the item must be reidentified by some method at the operation

which removed the original identification, if traceability is a requirement.

Marking generally refers to some method of printing identification on the item using ink, crayon, or other marking material. The marking must be legible and it must withstand subsequent processing unless provisions are otherwise made. Where marking is known to be removed by subsequent processing, reidentification must occur at the operation which removed the marking.

Marking is used for a variety of product. Examples include pipe, tubing, forged bars, mechanical parts, electrical components and parts, and welding rod and electrode. Marking by ink or crayon is frequently used for identification of items in process at fabrication stops. It provides a quick method of re-identification at operations where original marking is removed. Marking is also used for placing item identification on the item's shipping container.

Casting and molding identification refers to identification made by the mold for cast or molded products. The identification characters are typically indented in the mold which results in raised characters on the product. The inverse may also be used. The manufacturer's inspection of cast or molded products includes visual examination of identification for completeness, accuracy, and legibility.

Labeling refers to metallic or paper labels which have adhesive backing or which are attached by some adhesive material such as a glue. Because nameplates are less likely to separate from the item, nameplates are more likely to be used than labels if space is available. Labels tend to be used where nameplates cannot be used, due to space restrictions and marking or tagging is not practical. An example is small diameter wire and straight length welding rod. Labels are also widely used for placing item identification on the item's shipping container.

Tagging refers to the attachment of metallic or paper tags by wire or other fastening method. Tags are easily attached but also easily removed. Tags are frequently used for parts where other identification methods would interfere with functionability.

Vibra-tools are electrical vibrators with a carbide tip which marks items by indentation. Skillful use is necessary to provide legible characters. Vibra-tool marking is typically used for in-process or temporary marking.

With any of the identification methods, identification is applied directly to the item unless otherwise allowed by governing technical documents. Where identification is impracticable on the item, identification on the item's container is typically allowed. Examples include spooled wire, spooled welding electrode, and boxes of small parts such as threaded fasteners and pins.

## PROTECTIVE MEASURES

### Purpose

During the construction phase of nuclear power plants, items are received in advance of need dates insofar as possible. Advance receipt of items avoids loss of labor hours due to unavailability of materials, components, and equipment. From the time of receipt of items until the time of use of the items, protective measures are necessary to maintain quality of the items. Similar protective measures are necessary in the operations phase for repair parts. In order to quickly support maintenance operations, an inventory of repair parts is kept on-hand. Protective measures are necessary to maintain quality of such parts. Protective measures commence with the packaging and shipment

of items by the supplier and end with the installation of items into plant systems. Thus, protective measures serve to prevent damage, deterioration, and contamination of items during the activities of packaging, shipping, receiving, handling, storage, and issue.

### Classification of Protection

Specific protective measures which are necessary are dependent on the nature of the specific item to be protected. Nonetheless, it is possible and practical to group items by general levels of protection. Items within a given group are given a corresponding general level of protection with any additional specific protection dependent on the specific nature of each item. An analogy is found in the supermarket. One can categorize items in the supermarket by levels of temperature protection. The categories are frozen, chilled, and ambient. Within these categories, further protection is dependent on the item. For example, most canned goods and bread products are both at ambient temperature but are physically segregated to avoid damage to the more vulnerable bread products.

Four levels of protection are provided for nuclear power plant items. Items are categorized as requiring Levels A, B, C, or D protection. Within each level, there can be a range of controls such that the detailed protective measures applicable to a given item are dependent on the nature and importance of the item.

The purchaser of items is responsible for categorizing items by level of protection. The purchaser may directly categorize items or may identify the levels of protection to the supplier and require the supplier to categorize the item. In the event the supplier packages items of different levels in the same package, the highest designated level of protection must be provided.



### Level A Classification

Items are categorized as level A if they are exceptionally sensitive to environmental conditions and require special protective measures for one or more of (1) narrow temperature limits, (2) sudden temperature changes, (3) humidity and vapors, (4) gravitational forces due to acceleration or deceleration, and (5) airborne contamination such as rain, snow, dust, dirt, salt spray, and fumes. An example of a level A item is electronic equipment whose components are highly sensitive to temperature, humidity, and chemical attack. Another example is chemicals whose exposure to either atmospheric conditions or temperatures outside defined limits cause undesirable chemical reactions. Another example is special nuclear material in gaseous, powder, or pellet form. Special nuclear material is either enriched uranium or plutonium.

### Level B Classification

Items are categorized as level B if they are sensitive to the conditions described for level A but do not require the special protection required by Level A. For example, level B items would not require as narrow temperature or humidity controls as level A items. Examples of level B items include electronic instrumentation, motors, generators, gaskets, seals, welding electrode, batteries, computers, air filters, control panels, and electrical switchgear.

### Level C Classification

Items are categorized as level C if they require protection from the environment, airborne contaminants, acceleration/deceleration forces, and physical damage but are not particularly susceptible to deterioration from water vapor, condensation, and large temperature variations. Examples of level C items include pumps, valves



fluid filters, compressors, auxiliary turbines, fans, blowers, and thermal insulation.

#### Level D Classification

Items are categorized as level D if they are less susceptible to the environment than level C. Such items require protection from airborne contamination and physical damage. Examples of level D items include heat exchangers, reactor vessels, steam generators, pressurizers, structural steel, electrical cable, and piping.

### PACKAGING

#### General

Packaging of items is required to prevent deterioration, contamination, and damage during the evolutions of shipping, handling, and storage. The degree of protection varies according to the nature of the item and conditions it is subjected to in shipment, handling and storage. Items are categorized as levels A, B, C, or D and packaged within the guidelines of the protection level and the specific protection measures required for the specific item.

#### Level A Packaging

The key materials for level A packaging are (1) barriers, (2) dessicants, (3) caps and plugs, and (4) containers or crates. These packaging materials are used to enclose the level A item in a vapor proof, dry atmosphere and to anchor and brace the item.

Barriers used for level A packaging are generally flexible material designed to withstand the penetration of water, water vapor, grease, and harmful gases. Thickness of the barrier material is selected such that the barrier

is not easily damaged by puncture, abrasion, weathering, cracking, wind conditions, and the like. Barriers used with stainless steel products must be non-halogenated. All barriers must be noncorrosive and fire retardant. Level A items which are not damaged by condensation are dried and placed in barrier material without desiccants. The barrier need not be vapor-proof and it may be taped or sealed. Level A items which are susceptible to damage from condensation are dried and placed in vaporproof barrier materials with dessicant. In this case, the barrier is sealed. Also, the end which may be opened at receiving has sufficient extra barrier material to permit two openings and resealings.

Dessicants are dehydrating agents which absorb moisture from the air. Dessicants may be contained by bags or canisters. When used, dessicants are secured within the vapor-proof barrier in order to prevent damage to the item or barrier by movement of the dessicant. The use of dessicant and the number of bags or canisters must be included in the identification on the container or crate.

In lieu of dessicants, contact preservatives or inert gas blankets can be used. Contact preservatives must not be harmful to the item and must be removable by a cleaning agent which is not harmful to the item. The need for periodic reapplication of contact preservatives must be identified. Inert gas blankets may use nitrogen, helium, or argon, unless specified otherwise. A means of pressure measurements must be provided. The container must be marked to clearly show the use of an inert gas blanket for protection of the item.

Caps and plugs are used to seal all openings in level A items. They are also used to cover and protect from physical damage and features as threads, weld end preparation, and protuberances. In lieu of caps or plugs, pressure sensitive tape may be used to seal openings.

Containers or crates are required for level A items. Containers may be nailed wood boxes, fiberboard boxes with or without wood cleats, metal or fiber drums, or other specially designed container. Crates are a type of container which uses wood products or metal alloys in their construction. Crates are required for items in excess of 500 pounds. Skids are always used with crates to permit entry of lifting devices under the crate. Skids are also required on boxes having a gross weight of 100 pounds or more. Such skids must provide a minimum floor clearance as provided by four inch lumber.

The level A item within its barrier must be anchored, blocked, braced, and/or cushioned as necessary to prevent physical damage to the item or its barrier. Motion in six directions at right angles to one another must be prevented by blocking and bracing. Cushioning is used where protection from shock and vibration is required. Anchoring refers to fastening the item in a crate or on a skid. Bolting is the preferred anchoring method to facilitate removal of the item.

Containers for level A items are marked on at least two sides using waterproof ink or paint or tags or labels. As a minimum, identification marking must include (1) destination, (2) supplier's return address, (3) purchase order number, package number, and total number of packages, (4) material identification number, (5) handling instructions, (6) weight when in excess of 100 pounds, and (7) special instructions. Handling instructions include as appropriate: fragile, center of gravity, keep dry, this side up, sling here, do not freeze, and stacking limitations. Special instructions include notice of dessicants, inert gas blanket, special unpacking instructions or restrictions, and storage requirements.

### Level B Packaging

Level B packaging is the same as for Level A except that humidity control and special provisions for shock and vibration are not required. This means that barriers need not be sealed and dessicants are unnecessary. Also, the extent of cushioning necessary is typically less than for level A.

### Level C Packaging

Level C packaging includes the use of (1) containers or crates, (2) caps and plugs, (3) blocks, anchoring, and braces, and (4) identification marking on containers. Criteria for these items if similar to that described previously for level A packaging. Level C packaging provides protection from exposure to salt spray, rain, dust, dirt, and other airborne contaminants.

### Level D Packaging

Level D packaging includes the use of (1) caps and plugs, (2) blocks and braces if packed in containers, (3) suitable atmospheric protection as necessary, and (4) identification marking on containers or the item. All openings are capped or plugged. Where containers are used, adequate blocking, bracing, and possibly cushioning is used to prevent physical damage. If the item is susceptible to atmospheric damage, the item is suitably protected by either container or barrier materials. Identification to similar to that described for level A packaging.

## HANDLING

### General

Handling of received items employs equipment and techniques which minimize the possibility of damaging the items. Handling equipment is selected to be compatible with the item shape, weight, and lifting points. Where necessary, written procedures are developed which specify specific handling techniques.

### Lifting and Hoisting Equipment

Lifting and hoisting equipment is certified by the supplier as to its capacity. The certification identifies rated load, any special instructions pertaining to use of the equipment, and operating parameters for powered equipment. While there is a wide variety of such equipment, a few of the common hoists, lifts, and cranes are illustrated in Figure 31-4-1.

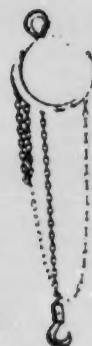
### Procedures and Techniques

Written handling procedures are prepared for the handling of items where planned detailed techniques are necessary to prevent damage. Such procedures are made necessary by (1) weight or size of the item, (2) susceptibility of the item to shock, (3) high nil ductility transition temperatures, or (4) other special conditions. Examples include reactor vessels, steam generators, turbines and switch gear. Such written procedures detail (1) weights, (2) sling locations, (3) balance points, (4) maximum hoist line speeds, and (5) other pertinent instructions such as use of spreader bars.





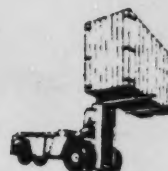
(a) Ratchet Chain Hoist



(b) Hand Chain Hoist



(c) Hydraulic Hand Truck



(d) Fork Lift



(e) Overhead Traveling Crane



(f) Truck Crane

Figure 31-4-1. Examples of Handling Equipment

Whether a written procedure applies, persons who handle items follow a cardinal rule. That is, handling equipment is never used for items whose weight exceeds the rated capacity of the handling equipment. The "weakest link in the chain" concept applies. Each load bearing member of the handling rig must have a rating equal to or greater than the weight of the item to be lifted. This includes hooks, slings, rings, and chains as well as the primary handling equipment. Safety rules and regulations may require that personnel performing material handling or hoisting operations be suitably trained in the use and maintenance of equipment

## STORAGE

### General

Storage of items must be such that the possibility of damage, deterioration, or contamination of items is minimized. The level of protection necessary is dependent on the nature of the specific items but within one of the defined four levels of storage. These levels are comparable to the packaging levels and the packaging provides much of the protection necessary during storage. Additional protection is provided as necessary by the use of buildings, heating and air conditioning systems, coverings, and administrative controls.

All storage areas are arranged and controlled in such a manner as to minimize handling of items and risk of accidental damage from vehicular traffic, cranes and hoists. Hazardous materials such as chemicals, paints, and solvents are stored in well ventilated areas not in close proximity to important nuclear plant items. All items in storage are arranged such that racks, cribbing, or crates support the weight of the item without distortion of the item. Also, identification is maintained on all items in storage. Items

are positioned in storage and that identification can be verified with minimal handling.

Large items are typically stored in their shipping crates on floor skids. Uncrated large items are typically stored on floor skids whether inside or outside storage applies. Smaller items are typically stored on shelves or racks such as that illustrated in Figure 31-4-2.

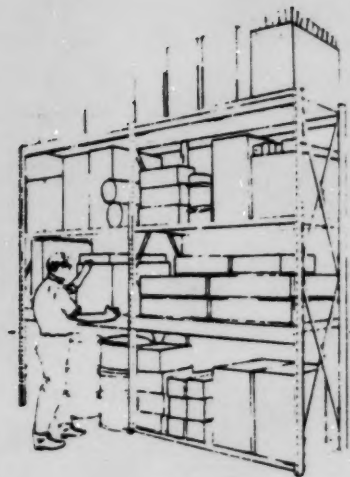
Cleanliness and housekeeping measures are used to minimize possibility of damaging or contaminating items in storage. Periodic cleaning of storage areas is accomplished to avoid the accumulation of trash, discarded packaging materials, and other soild. Foods and drinks are prohibited in storage areas. Salt tablet dispensers are prohibited. Rodent control should be provided as necessary.

#### Level A Storage

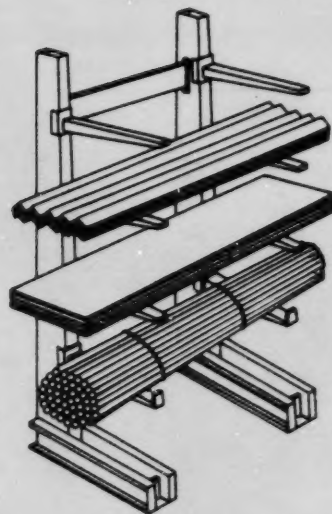
Buildings or equivalent enclosures are provided for level A storage which are constructed to be fire resistant, tear resistant, weathertight, and well ventilated. The structure is located so as not to be subjected to flooding. It has paved floors or equal which are well drained. Temperature and humidity is controlled within the limits specified for the level A items. Such control is typically localized in the area of level A storage although it could be applied throughout the building. The building's ventilation system is equipped with filters to remove dust and harmful vapors. Items are stored on pallets or shoring to provide for suitable ventilation.

#### Level B Storage

Level B storage is similar to level A except that humidity control is not required and temperature is controlled only between 40°F and 140°F unless a level B item requires narrower temperature limits. All other provisions of level A storage apply for level B.



(a) Multi-Tier Shelving



(b) Cantilever Racks

Figure 31-4-2. Examples of Storage Equipment

### Level C Storage

Level C storage is indoor storage which does not require temperature control. The building is fire resistant and weathertight, has paved floors or equal, and is well drained. It should not be susceptible to flooding and rodent control should be provided. It does not require a heating system. Items are placed on pallets or shoring to provide air circulation.

### Level D Storage

Level D storage is outside storage. The storage area is marked, well drained, and reasonably removed from traffic areas. Gravel covered or paved areas are preferred. Items are stored on cribbing or equivalent to allow for air circulation and to avoid entrapment of water.

When protection from weather conditions is necessary, level D items are covered with flame-resistant sheeting or tarpaulins. Such coverings are placed to provide drainage and to insure air circulation to minimize condensation. The coverings are tied down to prevent moisture from entering laps and to protect the coverings from wind damage.

## INSPECTION

### Scope and Purpose

Inspections associated with identification, handling, and storage include (1) receiving inspection, (2) inspection of storage conditions, and (3) inspections of handling equipment. Receiving inspection determines acceptability of items upon receipt and involves techniques which are beyond the scope of this module. It is sufficient to recognize that receiving inspection is accomplished prior to storage



and that the handling techniques described by this module are utilized. Inspection of storage conditions and handling equipment is performed on a periodic basis as described

The purpose of inspections of storage conditions and handling equipment is to verify periodically that the integrity of items and their protection is maintained. Deficiencies found are documented and reported to the organization responsible for storage or handling for corrective action.

#### Inspection of Storage Conditions

The owner or an authorized contractor thereof is responsible for establishing an inspection program for storage. The inspection program is documented in the form of written inspection procedures which include frequency and type of inspections. The inspection program typically addresses (1) identification, (2) covers, plugs, and seals, (3) contact preservatives, (4) desiccants and inert gas blankets, (5) physical damage, and (6) cleanness.

Inspection for identification verifies that items and their containers remain identified as described previously in this module. As items are issued from stores in partial quantities, Material Services Technicians must ensure remaining quantities have proper identification. This may require technicians to complete additional identification tags in cases where one tag identifies a quantity of a given item. Also, improper storage and handling practices can result in loss or obliteration of identification. If inspection finds unidentified items, the items are treated as nonconforming until their identity has been positively determined.

Inspections of covers, plugs, and seals verifies that openings in items are plugged or sealed and that outside

storage items are covered as required. These devices prevent internal contamination and/or weathering of items and should remain in place throughout the storage period. Temporary removal of these devices should be followed by restoring the devices.

Inspections of contact preservatives verifies that the preservative is in good condition. The inspection determines that the preservative has neither deteriorated nor dislodged due to contact with other items or weather conditions. Reapplication of preservative is required as necessary to maintain a uniform coating.

Inspections of dessicants and inert gas blankets verifies that humidity control remains intact. Items with desiccants have a humidity indicator inside the barrier which is visible through the barrier. Inert gas blanket inspection is performed by measuring gas pressure. Typically, pressure must be at least 5 psig.

Inspection for physical damage is a visual inspection of randomly selected items. Items in each level of storage are typically inspected. If damage is observed, the item is considered as nonconforming pending disposition of the specific damage.

Inspection for cleanness is a visual inspection of items and storage spaces. This inspection also typically checks required temperature controls for level B storage. The inspection verifies compliance with housekeeping policies and maintenance of cleanness of items.

#### Care of Items in Storage

Certain items require maintenance during their storage period. Such maintenance is planned and documented by written procedures. Regardless of which department performs the maintenance, quality control inspectors typically verify

completion of maintenance on schedule as part of the storage inspection program. Typical maintenance items are as follows:

- periodic energizing of instrumentation
- continual energizing of space heaters within motors, generators, and other electrical equipment
- periodic insulation tests on motors and generators
- periodic rotation of shafts of rotating equipment to new positions.

### Inspections of Handling Equipment

The utility or its authorized contractor is responsible for developing and implementing a program of inspections of handling equipment. The program is documented in the form of written inspection procedures and administrative controls for scheduling the inspections. The inspection methods are (1) visual inspections, (2) nondestructive examinations, and (3) load tests.

Visual inspections are performed to detect evidence of deterioration of handling equipment. Items made subject to visual inspection include slings, cables, chains, hooks, turnbuckles, eyes, shackles, and powered hoisting equipment. Typical attributes covered by visual inspection are:

- fraying and wear of slings and cables
- cleanness of all items which possibly contact product
- deformation or yielding of hooks, turnbuckles, eyes, shackles, rails, beams
- lubrication of powered hoisting equipment

Nondestructive examination are performed to detect cracks in hooks, turnbuckles, eyes, and shackles. Magnetic particle examination is typically employed. The inspection program may submit all rigging items to this examination or it may identify only certain items of high rating or usage factor for this examination.

Load tests are typically performed on cranes and hoists which are used in handling operations which are so important as to require written handling procedures. The load test is typically a dynamic test when the test load is lifted, transversed, and lowered. Such dynamic load tests are typically required prior to use of the handling equipment for lifting of components which require handling procedures.



## EXERCISES

1. Identify criteria by which product is categorized into protection levels by completing the right hand column:

Protection Level

Product Criteria

A

B

C

D

2. Describe identification methods by completing the right hand column:

| <u>Method</u>      | <u>Description</u> |
|--------------------|--------------------|
| nameplate          |                    |
| stamping           |                    |
| marking            |                    |
| casting or molding |                    |
| labeling           |                    |
| tagging            |                    |
| vibra-tool         |                    |

3. Describe the protection afforded by packaging features by completing the right hand column:

| <u>Feature</u> | <u>Protection</u> |
|----------------|-------------------|
| barriers       |                   |



desiccants

caps and plugs

containers

inert gas blanket

contact preservative

blocks, braces, and  
cushions

4. Describe storage conditions for each level of protection by completing the right hand column:

Storage Level

Storage Conditions

A

B

C

D



## MATERIALS

The following materials are required to support this module:

sample of items packaged in containers or crates  
sample rigging consisting of wire slings, devices,  
eyes, shackles, hooks etc.

sample of rigging consisting of defective wire slings,  
hooks, shackles, etc., if possible



## PROCEDURES

1. Inspect received items assigned by the instructor. Complete data table 31-4-1 and discuss entries in class.
2. Inspect rigging and complete data table 31-4-1 and discuss entries in class.
3. Tour a construction site storage facility. Take notes on (a) type of structure, (b) atmospheric controls, (c) methods of storage, (d) housekeeping, (3) identification of items. Discuss notes in class.



# DATA TABLE

TABLE 31-4-1  
Inspection of Packaging

Item Name: \_\_\_\_\_ Number: \_\_\_\_\_

Description of container:

---

---

---

Identification on container:

Type: \_\_\_\_\_ Location: \_\_\_\_\_

Entries: \_\_\_\_\_

---

---

---

Identification on Item:

Type: \_\_\_\_\_ Location: \_\_\_\_\_

Entries: \_\_\_\_\_

---

---

---

Record results of inspection for cleanness and evidence of damage: \_\_\_\_\_

---

---

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TABLE 31-4-2  
Inspection of Rigging

| Item | Results of Visual Inspection |
|------|------------------------------|
|      |                              |
|      |                              |
|      |                              |
|      |                              |
|      |                              |
|      |                              |



## REFERENCE MATERIALS

- Juran, J.M., Quality Control Handbook, 1974, McGraw Hill, Inc.
- ASME, Quality Assurance Program Requirements for Nuclear Power Plants, ANSI N45.2, The American Society of Mechanical Engineers
- ASME, Quality Assurance Requirements for Control of Procurement of Items and Services for Nuclear Power Plants, ANSI N45.2.13, The American Society of Mechanical Engineers
- ASME, Packaging, Shipping, Receiving, Storage, and Handling of Items for Nuclear Power Plants, ANSI N45.2.2, The American Society of Mechanical Engineers
- ANS, Administrative Controls and Quality Assurance for the Operational Phase of Nuclear Power Plants, ANS 3.2/ANSI N18.7, American Nuclear Society





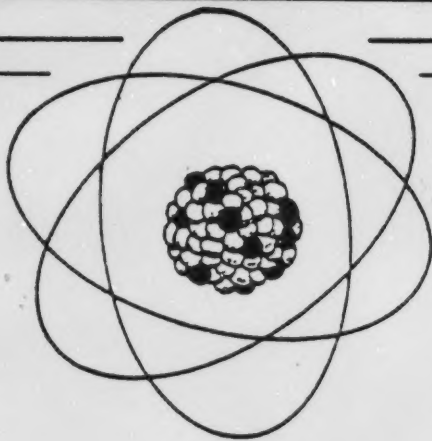
# TEST

1. Describe these identification methods:
  - a. nameplate
  - b. marking
  - c. tagging
2. Protective measures are applied to products throughout the activities of shipping, receiving, handling, and storage; what is the purpose of such protective measures?
3. Items are categorized as requiring protection level A, B, C, or D; describe the product characteristics used to categorize product for each level.
  - a. Level A -
  - b. Level B -
  - c. Level C -
  - d. Level D -

4. Describe the protection afforded by the following packaging features:
  - a. barriers
  - b. caps and plugs
  - c. blocks, braces, and cushions
5. Describe the identification of containers including five types of information required to be identified.
6. Differentiate between level A and level B storage.
7. Describe level D storage.
8. Briefly describe inspections of storage conditions with respect to:
  - a. covers, plugs and seals
  - b. physical condition
  - c. cleanness
9. Briefly describe inspections of handling equipment with respect to:
  - a. visual inspections

b. nondestructive examinations

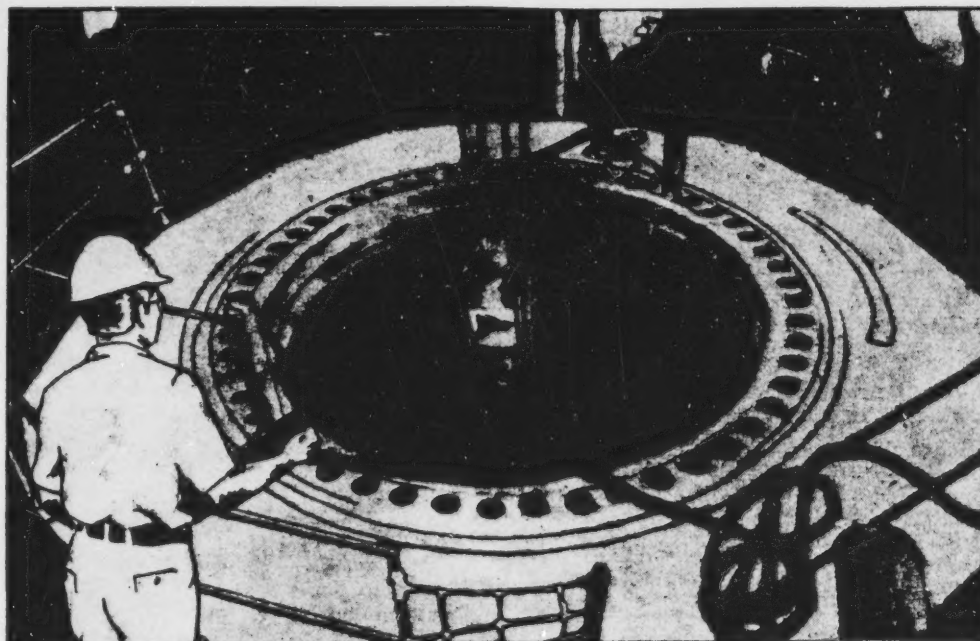
c. load tests



# NUCLEAR TECHNOLOGY

## MODULE 31-5

### NON-CONFORMING MATERIALS



## COURSE 31 QUALITY ASSURANCE PRACTICES



CENTER FOR OCCUPATIONAL RESEARCH AND DEVELOPMENT

4800 LAKEWOOD DRIVE WACO, TEXAS



## COURSE MODULES

### COURSE 31      QUALITY ASSURANCE PRACTICES

- MODULE 31-1      Overall Quality Assurance Program
- MODULE 31-2      Vendor Qualification
- MODULE 31-3      Receiving Inspection
- MODULE 31-4      Identification, Storage and Handling  
                         of Components, Parts and Materials
-  MODULE 31-5      Non-Conforming Materials
- MODULE 31-6      Certification and Qualification of  
                         Quality Control Inspectors
- MODULE 31-7      Auditing for Quality Assurance
- MODULE 31-8      Document Handling, Storage and  
                         Retrieval for Quality Assurance

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## INTRODUCTION

The Nuclear QA/QC technician serves an important role with respect to nonconformances. First, it is this technician who may detect the nonconformance and report it. The report must furnish all necessary information to permit another organization to determine what actions will be taken. Secondly, the QA/QC technician may be responsible to release a nonconforming item for use after it has been corrected. Finally, the QA/QC technician is frequently involved in preparing nonconforming material control system procedures and with auditing for compliance with these procedures.

While an effective quality assurance program is aimed toward preventing the generation of nonconformances, deficient hardware can be expected to occur. Therefore, the quality assurance program must include ample inspections and tests to detect nonconformances that may occur. Once an item is found to be nonconforming, the nonconforming material control system insures that it will either not be used or that it will be corrected prior to its use.

This module describes the essential elements of a nonconforming material control system, including their purpose and application.



## MODULE PREREQUISITES

The student shall have completed all previous modules of Course 31.



## OBJECTIVES

Upon completion of this module, the student/trainee can:

1. Define the terms nonconformance, identification, documentation, segregation, disposition, and notification as they pertain to the nonconforming material control system.
2. State the overall purpose of the nonconforming material control system.
3. Name five essential elements of a nonconforming material control system and describe the role of each.
4. Describe methods of identifying nonconforming items.
5. Describe the types of information typically documented by the nonconformance report.
6. Name four types of dispositions of nonconformances and describe each.
7. Name two notifications a company makes to external parties and state the purpose of each.
8. State the purpose of hold notices, stop work orders, and conditional releases.
9. Determine to whom nonconformance reports are best addressed.
10. Recognize the essentiality of follow-up actions on a nonconforming item.
11. Learn which individual or section can accept responsibility for dispositioning nonconformances.



## NOTES TO INSTRUCTOR

The activities suggested by this module may require the use of typical procedures for the control of nonconforming materials. Copies of such procedures may be obtained from nearby nuclear companies such as utilities, construction contractors, and component suppliers.



# SUBJECT MATTER

## NONCONFORMING MATERIALS CONTROL SYSTEM

### Definition of Nonconformance

Nonconformance is defined as a deficiency in characteristic, documentation, or procedure which renders the quality of an item unacceptable or indeterminate. Characteristic refers to any property or attribute of an item that is distinct, describable and measurable. Examples of characteristics include materials properties, dimensions, configurations, assemblies and functions. Documentation refers to any written or pictorial information describing, defining, specifying, reporting or certifying activities, requirements, procedures or results that effect the characteristics of an item. Examples include drawings, specifications, inspection reports, and test reports. Procedure refers to written instructions whose execution affects or determines the characteristics of an item. Examples include manufacturing, inspection, test, installation, startup, operating and maintenance procedures. As can be seen in these definitions, the term nonconformance is always related to hardware. Either the hardware itself does not comply with design requirements or a deficiency in documentation or procedure renders it impossible to determine that the hardware complies with design requirements, or the design requirement is in error.

### Purpose of Nonconforming Material Control System

The quality assurance program is intended to prevent and detect nonconformances. While prevention of nonconformances and detection of nonconformances appear to be opposite objectives, reality forces the use of both objectives and frequent comparison of their achievement. When one considers what effort would be required to absolutely

prevent any nonconformance, the magnitude of the effort presents costs that outweigh the benefits. If not all nonconformances can be reasonably prevented, the quality assurance program should enable detection of nonconformances which do occur. Because nonconformances also represent costs in repair, rework, or replacement, the number and severity of nonconformances influence the level of effort to prevent them. That is, when numerous or costly nonconformances are being detected, more effort is placed on their prevention.

From the above discussion, it is concluded that nonconformances may occur from time to time and that the quality assurance program detects such nonconformances. While the number and severity of nonconformances should be minimal it is imperative that the quality assurance program prevent inadvertant use of items which are found to be nonconforming. Therefore, the purpose of the nonconforming material control system is to control nonconforming items from the point of their identification to the point of their correction in order to prevent the inadvertant use of nonconforming items.

#### Five Essential Elements

The nonconforming material control program consists of five essential elements. These essential elements are (1) Identification, (2) Documentation, (3) Segregation and Storage, (4) Disposition, and (5) Notification.

Each company describes in its quality assurance procedures the responsibilities and methods of implementing the essential elements of control of nonconforming materials. The overall process is illustrated by the flow charts in Figure 31-5-1.

Essential Element

Activities

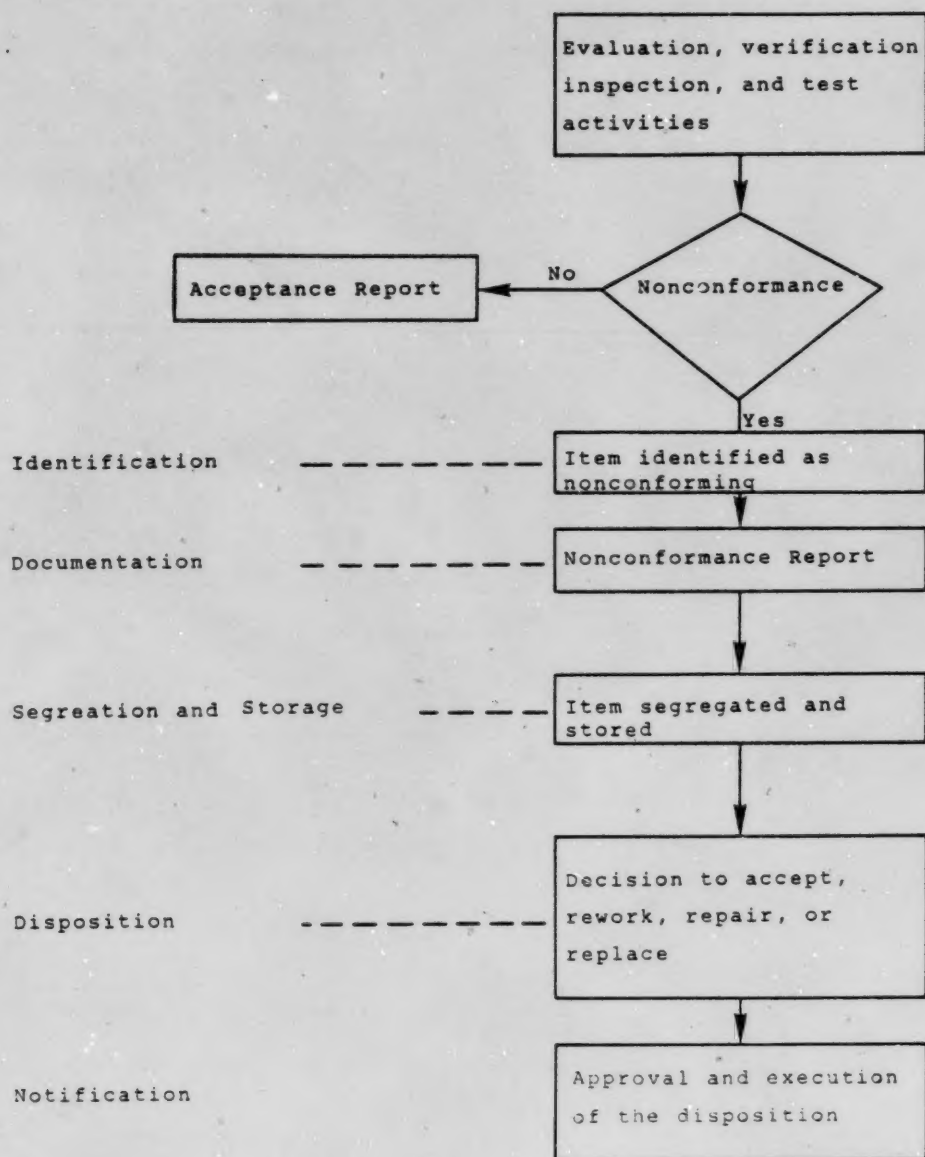


Figure 31-5-1. Flow Chart of Nonconforming Material Control Activities



## ESSENTIAL ELEMENTS OF NONCONFORMING MATERIAL CONTROL SYSTEM

### Identification

Once an item is found to be nonconforming, it cannot be used until the nonconformance is dispositioned. To prevent inadvertant use or installation of a nonconforming item, it is essential that the item be clearly identified as nonconforming. An identification method is selected which makes it apparent at a casual glance that the item is nonconforming. While the specific identification method varies among companies, acceptable methods including labeling, tagging and marking. Red or international orange colors can be used to enhance visibility of the identification and black non-fading ink should be used to fill in the tag blanks. A typical tag is illustrated in Figure 31-5-2.

The tag is a rectangular label with a pointed left side. On the left side, the word "REJECT" is written vertically in large, bold, capital letters. To the left of the word is a small circle. To the right of the word are five horizontal lines for text entry. The first line is labeled "Hold - Nonconforming Item". The second line is labeled "Item Number". The third line is labeled "Item Name". The fourth line is labeled "Nonconformance Report No.". The fifth line is labeled "Description of Defect". At the bottom right of the tag, there is a horizontal line labeled "Signature/Date".

|                      |                                 |
|----------------------|---------------------------------|
| REJECT               | Hold - Nonconforming Item       |
|                      | Item Number _____               |
|                      | Item Name _____                 |
|                      | Nonconformance Report No. _____ |
|                      | Description of Defect _____     |
| Signature/Date _____ |                                 |

Figure 31-5-2. Example Nonconformance Tag

Material used for identification labels, tags or marking must be durable and not detrimental to the item. In this regard, adhesives used on identification labels

which could be used on austenitic stainless steel must be free of halogens such as chlorine and fluorine. Such halogens could cause cracking if the material is subsequently placed in a high temperature, high stress system. Tags are either metallic or of thick, stiff paper and are physically attached to the item. Marking materials are indelible and also free of deleterious materials such as halogens.

The nonconforming identification on items gives notice that such items are not to be used or installed as long as the nonconformance identification remains on the item. Therefore, this element of the control system requires that the nonconforming material control procedure establish responsibilities and methods for placement and removal of nonconformance identification. Placement of nonconformance identification is normally the responsibility of the person who performed the activity which detected the nonconformance. Responsibility for removal of the nonconformance identification is normally assigned to the same group of individuals who placed the identification on the items. However, some companies designate quality control technicians as having sole authority for removal of nonconformance identification. In any event, the identification is removed only after satisfactory correction of the nonconformance.

#### Documentation

Once an item is identified as nonconforming, it is logical to attempt to salvage the item if technically possible. For example, rework or repair may be less costly than replacement. Whatever happens to the item, documentation is needed to provide objective evidence that the nonconformance was either corrected or the item was not kept in service, used or installed.

Most companies use special forms for documentation of nonconformances such that a single page form provides for all necessary entries. Frequently, the forms are multi-copy forms which produce several carbon copies as entries are made on the original. Figure 31-5-3 illustrates a typical form.

|                                                                                                                                                                  |  |                                                            |                    |                                    |  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|------------------------------------------------------------|--------------------|------------------------------------|--|
| Quality One                                                                                                                                                      |  | NONCONFORMING REPORT                                       |                    | NO.                                |  |
| I SYSTEM                                                                                                                                                         |  |                                                            | PREPARED BY        |                                    |  |
| SUBSYSTEM I.E. NO.                                                                                                                                               |  |                                                            | LOCATION           |                                    |  |
| SUBSYSTEM NAME                                                                                                                                                   |  |                                                            | DATE               |                                    |  |
|                                                                                                                                                                  |  |                                                            | PURCHASE ORDER NO. |                                    |  |
| II DESCRIPTION OF NONCONFORMANCE                                                                                                                                 |  |                                                            |                    |                                    |  |
|                                                                                                                                                                  |  |                                                            |                    |                                    |  |
| III REPAIR ACTION AND 100% SAMPLE SIZE ACTION REQUIRED                                                                                                           |  | IIIa Supervisor Signature Required                         |                    | IIIb INITIAL and DATE              |  |
| YES <input type="checkbox"/>                                                                                                                                     |  |                                                            |                    |                                    |  |
| NO <input type="checkbox"/>                                                                                                                                      |  |                                                            |                    |                                    |  |
| IV REPAIR ACTION (Check One)                                                                                                                                     |  |                                                            |                    |                                    |  |
| ACCEPT <input type="checkbox"/> REJECT <input type="checkbox"/> REPAIR <input type="checkbox"/> ASSEMB <input type="checkbox"/> REPLACE <input type="checkbox"/> |  |                                                            |                    |                                    |  |
| V REPAIR INSTRUCTIONS AND TECHNICAL AUTHENTICATION                                                                                                               |  |                                                            |                    |                                    |  |
|                                                                                                                                                                  |  |                                                            |                    |                                    |  |
| VI REPAIR RESULTS AND APPROVAL                                                                                                                                   |  |                                                            |                    |                                    |  |
| This description and repair is acceptable <input type="checkbox"/> Not acceptable <input type="checkbox"/>                                                       |  |                                                            |                    |                                    |  |
| VII REPAIRING REVIEW BOARD (Required on all unacceptable repairs)                                                                                                |  |                                                            |                    |                                    |  |
| REVIEWER                                                                                                                                                         |  | DATE                                                       |                    | REVIEWER SIGNATURE                 |  |
| REVIEWER NAME                                                                                                                                                    |  | DATE OF REVIEW                                             |                    | REVIEWER SIGNATURE                 |  |
| VIII REPAIR / REWORK / REPLACE COMPLETE and ACCEPTABLE                                                                                                           |  |                                                            |                    |                                    |  |
| REPAIR / REWORK / REPLACE COMPLETE                                                                                                                               |  | DATE                                                       |                    | REPAIR / REWORK / REPLACE COMPLETE |  |
| IX REPAIR COMPLETE and ACCEPTABLE                                                                                                                                |  |                                                            |                    |                                    |  |
| REPAIR COMPLETE                                                                                                                                                  |  | DATE                                                       |                    | REPAIR COMPLETE                    |  |
| X SIGNATURE                                                                                                                                                      |  | XI SUPERVISOR ACTION                                       |                    |                                    |  |
|                                                                                                                                                                  |  |                                                            |                    |                                    |  |
| DEFINITION                                                                                                                                                       |  | Manager's Signature (Required on all unacceptable repairs) |                    | Chief Engineer (11)                |  |
|                                                                                                                                                                  |  |                                                            |                    | QAB 11 / QAB 1                     |  |

Figure 31-5-3. Nonconformance Report

For the form in Figure 31-5-3, space is provided in the upper right hand corner to record a unique serial number for the nonconformance report. The serial number permits

reference by all subsequent actions to this unique identifier. This same number is also placed on the nonconforming tag, label, or marking identification method described previously. To avoid use of duplicate numbers and thereby maintain the cross-reference capability, companies either preprint consecutive numbers on the supply of forms or maintain a log of numbers at a central point of issue.

Sections I and II of the form in Figure 31-5-3 permit recording a description of the nonconformance. A complete description is necessary in order to assist proper dispositioning at a later time. When necessary to give a complete description, hand drawn sketches are attached to the form. The preparer signs and dates the form upon completion of sections I and II.

The remainder of the form in Figure 31-5-3 pertains to disposition and notification which are described later. In summary, documentation describes the nonconformance and records the disposition and subsequent notifications which carry out the disposition.

#### Segregation and Storage

In addition to identifying items as nonconforming, measures are taken to segregate nonconforming items from those which are acceptable. Segregation further safeguards against the inadvertent use or installation of a nonconforming item by physically separating nonconforming items from conforming items.

Special storage areas are established for nonconforming items. Typically such storage areas are designed and constructed to separate by barriers, partitions and other such means, nonconforming items from those which are acceptable. Access to the "quarantine" areas is limited and no items

released without appropriate documentation. Storage conditions are maintained in a manner to prevent deterioration of the item because it may be reparable.

Physical size of items or special storage requirements may make segregation of nonconforming items impractical. In such cases, the physical identification on the item is relied upon to prevent inadvertant use.

### Disposition

Disposition is the determination of destiny of the nonconforming item. A company's engineering section normally has responsibility for dispositioning nonconformances. Either the quality assurance section or a special committee reviews dispositions to assure that proper decisions have been made. In all cases, design criteria govern the dispositioning decisions.

There are four types of dispositions: accept as is, reject and replace, repair, and rework. Each of these are described as follows:

- Accept as is - A decision to accept a reported nonconformance without replacement, rework, or repair is possible for three reasons. First, the reported nonconformance may be in error, i.e., while the acceptance criteria was thought to have been violated, it was not. In such cases, the preparer of the nonconforming report probably misapplied the acceptance criteria or failed to use the proper acceptance criteria. Secondly, more stringent acceptance criteria may have been in use than required by the specified design limits. Considering the saw, "give them an inch and they will take a mile", some companies frequently work to somewhat more stringent acceptance criteria than absolutely necessary. If the inspection or test result falls outside this more stringent criteria



but within specified design limits, the reported nonconformance is accepted. Thirdly, a deviation from specified design limits may be approved by the design agency. Such deviations are approved only when the nonconformance does not affect safety, assembly, interchangeability, and function of the item.

- Reject and replace - A decision to reject and replace a nonconforming item results from an uncorrectable nonconformance or one so costly to correct that replacement is cheaper. The disposition to reject and replace includes instructions for disposing of the item. If it is still under vendor warranty, it is returned to the vendor for replacement. If not, it may be scrapped or designated for use in another less stringent environment where it is acceptable. For example, if a valve rated at 600 psia were reported as nonconforming because it had been released for use in a 1200 psia system, it could be reassigned to another system rated at 600 psia or less. In such case, replacement is made from stores or by procurement of a replacement item.
- Repair - A decision for repair is based on the ability to bring the item to a conforming status via a repair process. Such repair processes include welding, brazing, heat treating, and forming. Whenever repair is specified, repair instructions are delineated on the nonconformance report or by referencing a specific repair procedure. The instructions include inspection of the repair.
- Rework - A decision to rework the item is based on the ability to bring it to a conforming status via normal processing. Rework differs from repair in that it involves only the original processing

steps to bring the item to a conforming status. Repair involves processing steps that were not originally planned. For example, if an outside diameter is found to be oversize, rework by repeating the original machining step is done. Similarly, if washers on threaded fasteners are missing, rework is accomplished by repeating the assembly procedure.

The basis for each disposition is documented by the dispositioner. The basis may be pre-established in the form of design documents, codes and standards. If these technical documents do not establish a basis for accept as is, rework or repair dispositions, there remains two alternatives: reject and replace or review design. For the first alternative the item will not be used or installed and no further basis is needed. For the second alternative, a design review establishes the technical basis for accept as is, rework or repair dispositions. In Figure 31-5-3, sections IIA and IV of the sample form are used to document design review.

Whenever rework, repair or replacement dispositions are made, the disposition also determines if previously completed tests are affected and specific inspections of the reworked, repaired or replacement item. The disposition indicates on the nonconforming report what tests, if any, need to be repeated. For example, if a valve passed hydrostatic test but required replacement of the disk due to excessive seat leakage, another hydrostatic test would be needed after installation of the replacement disk. Inspection of the reworked, repaired or replacement item is intended to not only insure that the nonconformance is corrected but also to determine that no other nonconformance was generated in the process. A replacement item receives the same complete inspection that the original item received. A reworked or repaired item receives inspection based on the

method of rework or repair. For example, if rework by machining is accomplished, the feature that was machined and feature(s) that interface with the machined surface are inspected. In this regard, machining of an oversized outside diameter requires subsequent inspection of the diameter, wall thickness, concentricity, roundness and run out if these were all drawing features. For another example, repair by welding normally includes non-destructive testing for weld integrity and dimensional inspection for distortion.

To assure all the above considerations occur, the non-conforming material control procedure assigns responsibilities for:

- Dispositioning decision including evaluation of retesting and the recording thereof
- Reviewing and approving the decision of the disposition
- Designating or preparing repair instructions
- Designating rework instructions
- Accomplishing inspections of repaired, reworked and replacement items
- Accomplishing testing of repaired, reworked and replacement items.

#### Notification

Notification is the reporting of nonconformances to persons or companies designated as responsible for acting on nonconformances in some manner. This essential element spans the notifications from time of detection of a nonconformance until time of correction and removal of the nonconforming identification on the item. Its purpose is to trigger action by each responsible person or company upon receiving notification.

Notification and corresponding actions have a strong tendency to occur in series. The inspector initiates a

nonconformance report. The report is sent to the dispositioner. The dispositioner may correspond with the design agency. After disposition, the report is sent to the review committee who may in turn send it back to the department that caused the nonconformance. The responsible department enters cause and corrective action on the report (see Figure 31-5-3) and sends it to quality assurance for concurrence. Quality assurance sends the form back to the responsible department for carrying out the disposition. If replacement is needed and if a replacement item is not on hand, a replacement item must be purchased. This brings to play the pertinent procurement actions described in modules 31-1, 31-2, 31-3, and 31-4 with respect to requisitions, purchase orders, if there are delays in this process, quality assurance, inspection and handling. Meanwhile, the schedule coordinator is becoming frustrated with an item identified as nonconforming but not yet corrected. In fact, months can elapse before the item is corrected or replaced.

When schedules dictate rapid correction of nonconformances, the nonconforming material control system is severely tested. Its effectiveness depends on its ability to quickly disposition items when speed is important while at the same time preventing use or installation of the nonconforming item prior to correction. To help meet these goals, two features can be added to the system: parallel actions whenever possible and central coordination of actions.

Certain actions within the nonconforming material control system must be taken in series. These are the steps to disposition, review and approve the disposition, implement the dispositioning instructions, and inspect or test the item. Most other actions can be taken during the same time interval as these steps. Figure 31-5-4 lists typical series and parallel actions.

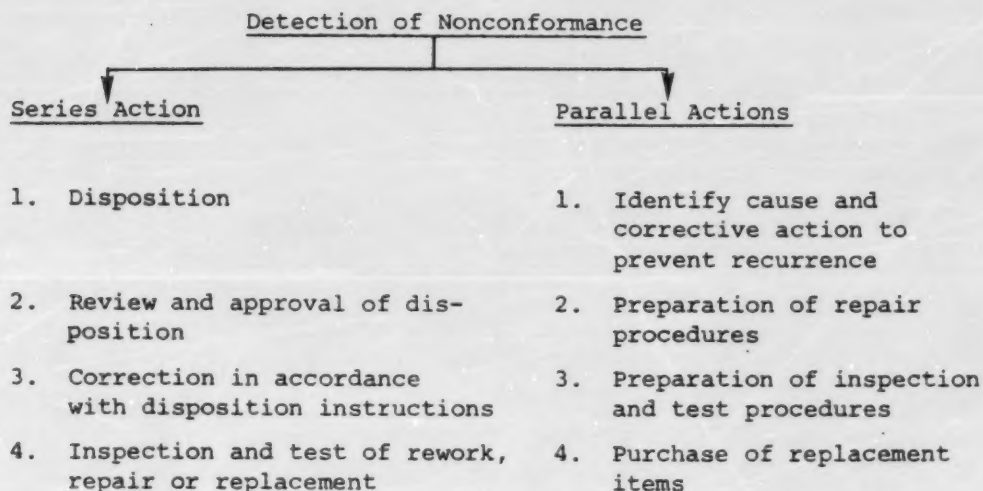


Figure 31-5-4  
Series and Parallel Actions of Nonconforming  
Material Control System

Assignment of a central coordinator permits one individual to track and expedite all necessary actions. This individual insures that items having highest priority receive first attention. Also, where necessary, this individual "walks" the nonconformance report through the system to expedite necessary actions. The ability to quickly disposition nonconformances when necessary, increases confidence in the workability of the system. This increased confidence helps to develop a desire by all departments to follow the system.

Parallel actions and central coordination are not workable without proper notifications. In general, notifications are necessary as follows:

- Copy of nonconformance report to the department responsible for the item. This copy is sent by the preparer of the report. It permits the department to determine the effect of the nonconformance on depart-



ment activities. It permits the responsible department to quickly determine cause and implement actions to prevent recurrence. Also, if it is obvious that a repair procedure will be needed, procedure preparation can immediately commence.

- Copy of nonconformance report to central coordinator. The central coordinator receives a copy at the time the nonconformance report is prepared and again after acceptance of the disposition. The first notification identifies an item to be tracked and the second identifies that the dispositioning instructions can now be carried out.
- Copy of dispositioned nonconformance report to quality assurance and test departments. This alerts these departments of inspections and for tests that will be needed. Necessary inspection and test procedures are prepared to coincide with the rework, repair or replacement actions.
- Copy of dispositioned nonconformance report to purchasing when replacement is the disposition. This permits early order of a replacement item. Copies of all serious nonconformances should go to company management.

All of the foregoing notifications have dealt with notifications within a company's organization. There are two additional notifications outside the company which may be required. These are notifications to (1) obtain customer approval of dispositions and (2) report nonconformances to the Nuclear Regulatory Commission (NRC).

Suppliers are typically required by procurement documents to obtain purchaser approval of the dispositions of certain nonconformances. In such cases, the dispositioned nonconformance report is forwarded to the purchaser for approval. Purchaser approval of nonconformance reports is

typically required whenever the nonconformance involves (1) violation of technical or material requirements of procurement documents, (2) violation of a purchaser approved document, (3) repair, and (4) a condition of nonconformance after rework or repair although the function of the item is unimpaired.

Title 10 of the Code of Federal Regulations, Parts 21 and 50 require the reporting to NRC nonconformances and failures pertaining to plant safety. Utilities typically require suppliers to make such reports to the utility who, in turn, submit required reports to the NRC. Since failures are normally handled via a nonconforming material control system, a mechanism is needed for issuing reports to NRC when required. The engineering organization that disposes nonconformances or a separate engineering section has responsibility for reporting to NRC. In either case, a copy of the nonconformance report is sent to the responsible group for use in meeting this reporting requirement.

## SPECIAL PROVISIONS

### Types of Special Provisions

In addition to the five essential elements of a non-conforming material control system, special supplementary provisions are adopted by many companies. The company's quality assurance program describes the responsibilities and procedures for special provisions. Typically, three special provisions are included. These are (1) hold notices, (2) stop work orders, and (3) conditional releases.

### Hold Notices

Hold notices are used for items suspected of being non-conforming but which require further investigation to make a determination. The purpose of a hold notice is to prevent further work on a particular item suspected to be nonconforming until a complete investigation is made. Work on everything else can continue. For example, an inspector may notice that one piece of many that are being welded does not have identity marking. A hold notice is issued and a hold notice tag is attached to the one piece. Welding of the remainder of the pieces continues. The inspector then determines if the identity of the piece can be established. If so, the piece is released for use by removal of the hold tag. If not, a nonconformance report is issued which replaces the hold notice and results in disposition of the item.

As another example, in the use of a hold notice, an inspector discovers that the assembly of an emergency core cooling pump is not following the approved procedure, a hold notice is issued and assembly stops. An investigation determines what effect the noncompliance has on the assembly. It may be necessary to disassemble all,

or a portion of the pump and reassemble it according to procedure to ensure that the pump has been properly assembled.

Use of a hold notice is typically limited to those instances where the persons performing the QA activity can independently make the necessary investigations. If assistance by other departments is necessary, the item is treated as a nonconformance and investigation is made via the dispositioning actions on the nonconformance report.

### Stop Work Order

A stop work order results in the immediate cessation of a work activity. Its purpose is to halt an activity that is obviously causing or about to cause nonconformances. As an example, concrete is being poured for the foundation of a reactor containment structure. It is discovered by an inspector that the aggregate report used to authorize concrete pouring represents a different batch than that being used. A stop work order is issued. The job foreman shall be immediately notified of the situation. All concrete work on the containment is brought to a halt pending an evaluation. It is noted that many man-hours and dollars can be lost as a result of such a stop work order. However, if the nonconformance had not been discovered, rectification of the problem at a later time could be far more costly. The example could conceivably result in dismantling and rebuilding much of the containment structure.

It should be evident that stop work orders are not issued indiscriminately. Detailed analysis of the situation is necessary to determine that such extreme action is warranted. Normally, the Quality Assurance Manager must concur in the issuance of stop work orders. Notification of higher management may also be required.

## CONDITIONAL RELEASE

A special type of supplementary disposition is the conditional release. Its purpose is to authorize limited use of the item pending completion of disposition in order to avoid schedular delays.

The conditional release system must insure that the item can be corrected and that it is in fact eventually corrected. The technical justification for the release is entered on the nonconformance report and conditional release is entered as a special instruction. Normally, the date or future sequence by which the nonconformance must be corrected is also entered. The person or committee who reviews dispositions then rules on the dispositioner's recommendations. If the conditional release is granted, quality control places a special tag or label on the item indicating its conditional release status and other pertinent information such as date or event by which correction must be accomplished. A log is normally maintained to list outstanding conditional releases and to permit followup actions that insure correction occurs. At the future time that disposition is completed, an inspection or test is conducted to verify compliance with the disposition. Acceptance is documented on the nonconformance report and the conditional release tag or label is then removed.

The conditional release system has many applications. In essence, it helps to avoid schedular delays which might otherwise result from the processing of nonconformance reports without conditional releases. Examples include release to continue manufacturing or installation up to a point where any possible disposition can still be carried out, release for use pending purchaser approval of the



disposition, and release for use pending design review. As indicated by these examples, risk is involved with conditional releases. Normally, the engineering group responsible for dispositioning nonconformances is also responsible for authorizing conditional releases. Such authorization is based on the engineering estimate that conditional release represents little risk. If great risk is anticipated, conditional releases are normally not used and the nonconforming item remains segregated until final dispositioning.

#### SUMMARY

In summary, then, this module has emphasized the following points regarding nonconforming materials.

- Nonconformance is a deficiency in characteristic, documentation, or procedure which renders the quality of an item unacceptable or indeterminate.
- The nonconforming material control system controls nonconforming items from point of identification to point of correction in such a manner as to prevent the inadvertant use of nonconforming items.
- The essential elements of a nonconforming material control system are (1) identification, (2) documentation, (3) segregation and storage, (4) disposition, and (5) notification.
- Identification is the physical tagging, labeling, or marking of nonconforming status which is clearly visible in order to preclude the inadvertant use of nonconforming items. Identification is removed upon completion of all dispositioning instructions.

- Documentation consists of the description of nonconformance and all dispositioning actions and notifications. It provides objective evidence that the nonconforming item is either corrected or replaced.
- Segregation and storage is the physical separation of nonconforming and conforming items under conditions of storage which protect the items from environmental damage. It further safeguards against the inadvertent use of nonconforming items.
- Disposition determines the destiny of nonconforming items. Potential dispositions include (1) accept as is, (2) reject and replace, (3) repair, and (4) rework. Disposition identifies all appropriate instructions and tests of repair and rework.
- Notification reports nonconformances to responsible persons and companies and triggers their actions as described by the nonconforming material control procedures. Notifications ensure that as a minimum, activities are carried out for disposition, review of disposition, implementation of disposition, and inspection and test of rework, repair or replacement.
- Notifications external to a company include (1) requests for purchaser approval of dispositions and (2) reports to the NRC on nonconformances and failures.
- Hold notices are sometimes used to prevent further use of a specific item until an investigation on the acceptability of the item can be completed.
- Stop work orders suspend activities which are causing or about to cause nonconformances.
- Conditional releases are authorizations for limited use of nonconforming items pending completion of all dispositioning actions.



## EXERCISES

The following exercises serve to reinforce the concepts presented by this module.

1. Obtain from the instructor a copy of a company's procedure for the control of nonconforming items and compare the content of the procedure with that of this module. Note additions and omissions and offer rationale for each.
2. Obtain from the instructor a copy of a company's procedure for the control of nonconforming items and list the name and purpose of each record format required by the procedure. Compare the purposes of these records with the essential elements of a nonconforming material control system as described by this module. State if adequate provisions are made for documentations and justify your determination.
3. Explain the overall purpose of a nonconforming material control system.
4. List five essential elements of the nonconforming control system and briefly describe the role of each.
5. Briefly explain why a nonconforming item must be tagged as being nonconforming.
6. Of what use is a nonconformance report?
7. Describe the typical contents of a nonconformance report.
8. Explain what is meant by a conditional release.
9. What is the purpose of a hold notice.
10. State the purpose of a stop work order.



## MATERIALS

The following materials are required to support this module.

1. Copies of various companies' procedures for controlling nonconforming items.
2. Sample tags, labels, and record forms used for documentation within a nonconforming material control system.



## PROCEDURES

Not applicable.



## DATA TABLE

Not applicable.



## REFERENCE MATERIALS

GPO, Code of Federal Regulations, Title 10, Energy, Parts O-199, U.S. Government Printing Office, 1978

ASME, Quality Assurance Program Requirements for Nuclear Facilities, ANSI N45.2, The American Society of Mechanical Engineers, 1977

ASME, Administrative Controls and Quality Assurance for the Operational Phase of Nuclear Power Plants, ANSI N18.7, The American Society of Mechanical Engineers, 1976

Juran, J.M., Quality Control Handbook, McGraw-Hill, 1974



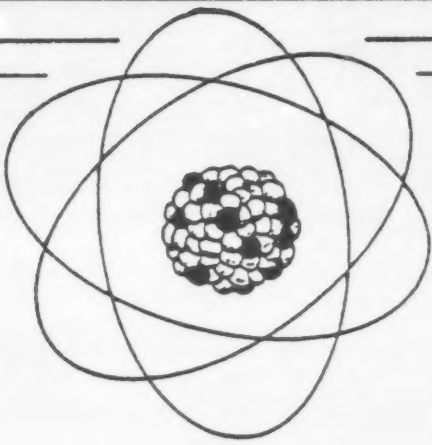


# TEST

1. Define:
  - a. Nonconformance
  - b. Identification
  - c. Documentation
  - d. Segregation
  - e. Disposition
  - f. Notification
2. State the overall purpose of the nonconforming material control system.
3. List five essential elements of the nonconforming material control system and briefly describe the role of each.
  - a.
  - b.
  - c.
  - d.
  - e.

4. Why is a nonconforming item tagged, labeled or marked as being nonconforming?
5. When can a nonconformance tag be removed from an item?
6. State the purpose of serializing nonconformance reports.
7. List four possible dispositions of a nonconformance report and describe the meaning of each.
  - a.
  - b.
  - c.
  - d.
8. Briefly describe the two notifications of nonconformances made external to the company whose product is found to be nonconforming.
9. Describe the contents of a typical nonconformance report.

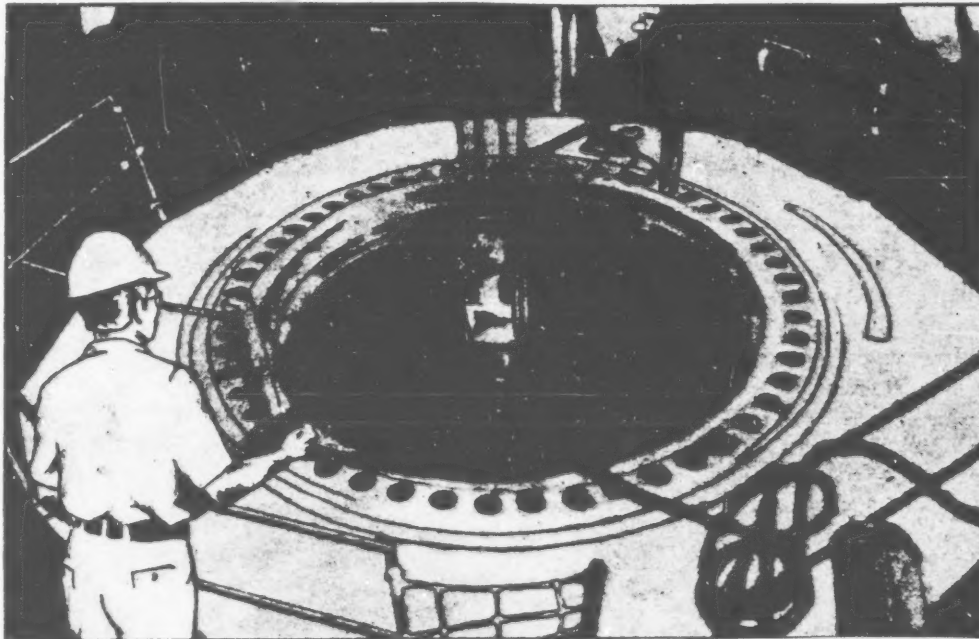
10. State the purpose of a conditional release.
11. State the purpose of a hold notice.
12. State the purpose of a stop work order.



# NUCLEAR TECHNOLOGY

## MODULE 31-6

CERTIFICATION AND QUALIFICATION OF QUALITY  
CONTROL INSPECTORS



COURSE 31 QUALITY ASSURANCE PRACTICES



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CENTER FOR OCCUPATIONAL RESEARCH AND DEVELOPMENT

4800 LAKEWOOD DRIVE WACO, TEXAS



## COURSE MODULES

### COURSE 31      QUALITY ASSURANCE PRACTICES

|                                                                                               |                                                                            |
|-----------------------------------------------------------------------------------------------|----------------------------------------------------------------------------|
| MODULE 31-1                                                                                   | Overall Quality Assurance Program                                          |
| MODULE 31-2                                                                                   | Vendor Qualification                                                       |
| MODULE 31-3                                                                                   | Receiving Inspection                                                       |
| MODULE 31-4                                                                                   | Identification, Storage and Handling<br>of Components, Parts and Materials |
| MODULE 31-5                                                                                   | Non-Conforming Materials                                                   |
|  MODULE 31-6 | Certification and Qualification of<br>Quality Control Inspectors           |
| MODULE 31-7                                                                                   | Auditing for Quality Assurance                                             |
| MODULE 31-8                                                                                   | Document Handling, Storage and<br>Retrieval for Quality Assurance          |

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## INTRODUCTION

A wide variety of inspections, examinations, and tests are performed to determine the acceptability of systems, components and parts to design requirements. Personnel who perform these activities must be certified as having adequate qualifications to competently perform assigned tasks. The Nuclear QA/QC Technician is responsible for becoming qualified for inspections and tests performed by the technician. Also, the Nuclear QA/QC Technician verifies that other organizations qualify their inspectors as required.

This module describes the program for qualification of personnel assigned to inspection and test activities. The qualification program consists of two parts with one part addressed toward nondestructive examination methods and the other part addressed toward all other quality control inspections and tests. A standard governs each part.

The student/trainee should become familiar with the elements of the overall qualification program and gain insight on the methods of obtaining specific qualifications. This will equip the student/trainee to understand entrance requirements into the QA/QC technician field. As will be seen in this module, the Nuclear QA/QC Technician curriculum is preparing the student/trainee to achieve formal qualification after some amount of on-the-job experience.



## MODULE PREREQUISITES

The student shall have completed all previous modules of Course 31.



## OBJECTIVES

Upon completion of this module, the student/trainee can:

1. Describe the application and the interrelationship of the two standards which govern certification and qualification of quality control inspectors.
2. State the purpose of an employer's written practice on personnel certification.
3. Describe the capabilities of individuals qualified to Levels I, II, and III.
4. Describe the physical prerequisites for qualification.
5. Describe in general terms the educational and experience prerequisites for qualification including the relationship of educational level, training courses, and on-the-job experience.
6. Describe the examination prerequisites for qualification including naming the types of examinations, their purpose, and minimum acceptable grades.
7. Describe the method of calculating composite grades of qualification examinations.
8. Name at least six types of information required for personnel certification records.



## NOTES TO INSTRUCTOR / STUDENT

One of the activities suggested by this module is the review of a company's written practice for the certification of personnel. Copies of companies' written practices may be obtained from companies involved in nuclear power plant work such as utilities, construction contractors, and component suppliers.



## SUBJECT MATTER

### STANDARDS

#### Regulatory Guidance

Criterion II of Appendix B to 10 CFR 50 includes the requirement that the Quality Assurance Program "shall provide for the indoctrination and training of personnel performing activities affecting quality as necessary to assure that suitable proficiency is achieved and maintained". The Nuclear Regulatory Commission (NRC) in its Regulatory Guide 1.58 identifies two standards that give satisfactory requirements for meeting this criterion of Appendix B to 10 CFR 50. These two standards are SNT-TC-1A, "Personnel Qualification and Certification in Nondestructive Testing" and ANSI N45.2.6, "Qualification of Inspection, Examination, and Testing Personnel for the Construction Phase of Nuclear Power Plants".

#### SNT-TC-1A

The American Society for Nondestructive Testing publishes SNT-TC-1A. This standard applies to the qualification of persons who have responsibilities for any of (1) Radiographic Testing, (2) Magnetic Particle Testing, (3) Ultrasonic Testing, (4) Liquid Penetrant Testing, (5) Eddy Current Testing, (6) Neutron Radiographic Testing, and (7) Leak Testing.

The standard requires the employer to establish a written practice which describes the criteria to be met by individuals for certification in any of three levels of qualifications. Levels of qualification are designated as I, II, and III. The employer's written practice must be consistent with the guidelines of the standard or be technically justified as establishing adequate criteria for qualifications for the specific test responsibilities assigned

to the employee. The standard gives guidelines for qualification criteria in three areas:

- Educational background and experience of the individual.
- Training by the employer or other party.
- Qualification examination administered by the employer.

#### ANSI N45.2.6

The American Society of Mechanical Engineers and the American National Standards Institute publish ANSI N45.2.6. This standard applies to persons having responsibilities for inspection examination, and test activities that assure the quality of important parts of a nuclear power plant during construction and operation. While the stated scope of the standard is limited to the construction phase, NRC Regulatory Guide 1.58 extends the application of this standard to fabrication of components and to the operations phase including preoperational and startup testing. However, this standard does not apply to those activities whose personnel qualifications are governed by SNT-TC-1A.

The standard requires the employer to identify those inspections, examinations and tests that require use of qualified personnel. The standard further requires the employer to establish a written practice for qualification of these personnel. The standard specifies minimum requirements which must be included in the written practice. Three levels of qualification (Levels I, II and III) are established and minimum requirements for each level are described for three areas:

- Educational background and experience of the employee
- Training given by the employer or other party
- Certification tests administered by the employer.

## LEVELS OF QUALIFICATION

### Comparison of SNT-TC-1A and ANSI N45.2.6

Both SNT-TC-1A and ANSI N45.2.6 establish three levels of qualification (ANSI N45.2.6 uses the terminology of "levels of capability"). The purposes of each level are essentially identical between the two standards. These levels reflect the typical organizational structure and corresponding skills associated with the various tasks that are necessary to plan for and accomplish an inspection, examination or test. A definitive expertise is required by each level of qualification.

### Level III Capabilities

The highest level of qualification (Level III) requires the individual to have broad experience and formal training in performance of inspections or tests and be knowledgeable on the principles and techniques of the inspections or tests. Level III qualification requires the individual to be capable of:

- Planning and supervising inspections and tests
- Preparing, reviewing or approving inspection or test procedures.
- Evaluating the adequacy of inspection or test activities.
- Organizing and reporting results of inspections or tests.
- Certifying the validity of inspection or test results.

### Level II Capabilities

The next highest level of qualification (Level II) requires the individual to be experienced and trained in the performance of the required inspections and tests and in the organization and evaluation of inspection results. Level II qualification requires the individual to be capable



of:

- Supervising or maintaining surveillance over others who are actually performing the inspections or tests.
- Calibrating, or establishing validity of calibration, of inspection and measuring equipment.
- Planning and setting up tests or inspections.
- Determining the validity of test results.

### Level I Capabilities

The next lower level of qualification (Level I) requires the individual to have experience or training in the performance of inspections or tests and be familiar with the tools and equipment required to carry out the assigned task. Level I qualification requires the individual to be capable of:

- Demonstrating proper use of tools and equipment that are necessary for the inspection or test.
- Demonstrating familiarity with the calibration of inspection and measuring equipment including controls associated with the calibration system such as labeling and recall procedures.
- Verifying that required equipment is in proper operating condition.

## PREREQUISITES FOR QUALIFICATION

### Summary of Prerequisites

Both SNT-TC-1A and ANSI N45.2.6 give recommended minimum requirements to be met as prerequisites for qualification in each of the three levels. These minimum requirements are not absolutes. Each company's written practice must include prerequisites for qualification which insure the employee possesses the knowledge, skills and physical capacities that are necessary for the inspections and tests

represented by the qualification. Such prerequisites must meet the minimum requirements of the standards or be technically equivalent.

Three categories of prerequisites for qualification are described by the standards: (1) physical, (2) educational and experience, and (3) certification examination. The QA/QC Technician may audit the qualification program for compliance with these prerequisites. Also, in the various monitoring functions, the QA/QC Technician assures that individuals performing inspection and test activities are in fact qualified to the required level. Finally, for those inspections and tests performed by the QA/QC Technician, the individual must meet the qualification criteria and be certified for the qualification level associated with the task.

#### Physical Prerequisites for Qualification

The physical prerequisites apply equally to any of the three levels of qualification. They pertain to the physical demands on the person to perform the activity and to the human senses (vision, smell, hearing, touch and taste). Of the senses, only vision is normally so important to one's capability of performing inspection and test activities as to merit prerequisite requirements. Inspections and tests involving the other senses normally include apparatus that performs the sensory function and displays or prints out the results. For example, acoustical testing apparatus normally prints out the magnitude and frequency of sound from the item being tested. Physical dexterity is normally tested solely by requiring the person to demonstrate the ability to perform the inspection or test activity. Therefore, the physical prerequisites are limited to (1) near distance visual activity, (2) color discrimination, and (3) other physical prerequisites established by the employer.

- Natural or corrected near distance visual acuity - SNT-TC-1A requires the capability to read with at least one eye Jaeger Number 2 letters (J-2) at a distance of not less than 12 inches or to perceive an Ortho-Rater minimum of 8 or perceive a similar test pattern. ANSI N45.2.6 requires reading of Jaeger Number 1 letters (J-1) or equivalent test for near vision. Both standards permit qualification to these requirements with natural or corrected vision and they require retesting for near vision on an annual basis.
- Color discrimination - Both SNT-TC-1A and ANSI N45.2.6 require testing of color vision when such vision is necessary in the performance of the inspection and test activities. The acceptance criteria is established by the employer based on the color discrimination required by the inspection or test. Examples of such tests are chemistry tests whose results are measured in terms of color changes to a solution or test device. Color vision tests need not be repeated because an individual's color perception does not change with age.
- Other physical requirements established by the employer - Both SNT-TC-1A and ANSI N45.2.6 charge the employer with determining if other physical prerequisites should be established. Where considered necessary, the employer will describe such additional prerequisites in the qualification criteria including the frequency for reexamination of these prerequisites. For example, the capability to interpret radiographs involves the ability to distinguish contrasts in various shades of grey. Therefore, vision tests for radiographic inspectors often include test radiographs which have density pattern of various

densities which must be discerned by the employee.

### Education, Training, and Experience Prerequisites for Qualification

The specific prerequisites for education, training, and experience vary with the level of qualification. Again, the standards give minimum requirements that can be adjusted by the employer to give consideration to other qualifying education, training or experience. These prerequisites are considered in composite forms, i.e., higher levels of education permit less on-the-job training and experience prior to qualification while lower levels of education require more on-the-job training and experience. Prior training courses that are specifically related to the inspections and tests also permit reduction of on-the-job experience.

Since the prerequisites for education, training, and experience differ between SNT-TC-1A and ANSI N45.2.6, each are presented separately below.

### SNT-TC-1A Prerequisites for Education, Training and Experience

SNT-TC-1A gives recommended training curricula for the seven test methods governed by this standard. Within the curricula, minimum hours of instruction and experience on each topic are established based on the educational background of the employee and the level of qualification to be achieved. Training and experience previously received by the employee may be credited if it specifically covers the topics within the recommended curriculum. Assuming no prior training or experience which specifically pertains to the nondestructive test method, the total hours of training and experience given in Table 31.6-1 are required for Levels I and II qualification.

To be eligible for Level III qualifications, the employee must satisfy any one of the following education and experience

| TRAINING (HOURS)                                                                                                                    |         |          |         |          |         |          |         |          |         |          |         |          |
|-------------------------------------------------------------------------------------------------------------------------------------|---------|----------|---------|----------|---------|----------|---------|----------|---------|----------|---------|----------|
|                                                                                                                                     | RT      |          | MT      |          | UT      |          | PT      |          | ET      |          | NRT     |          |
|                                                                                                                                     | Level I | Level II | Level I | Level II | Level I | Level II | Level I | Level II | Level I | Level II | Level I | Level II |
| * Completion with a passing grade of at least 2 years of engineering or science study at a university, college, or technical school | 12      | 30       | 8       | 4        | 24      | 40       | 4       | 4        | 8       | 8        | 12      | 40       |
| **High school graduation, diploma or its equivalent                                                                                 | 20      | 40       | 12      | 8        | 40      | 40       | 4       | 8        | 12      | 8        | 20      | 40       |
| ***Grammar school graduation, or demonstrated proficiency, or additional training                                                   | 80      | 100      | 24      | 16       | 40      | 80       | 12      | 16       | 48      | 24       | NA      | NA       |
| WORK TIME EXPERIENCE (MONTHS)                                                                                                       |         |          |         |          |         |          |         |          |         |          |         |          |
| All educational levels as listed above                                                                                              | 1 mo.   | 9        | 1       | 1        | 3       | 9        | 1       | 2        | 1       | 9        | 6       | 24       |

| LEAK TESTING                                                                                                                        |                |       |       |      |          |      |      |      |  |
|-------------------------------------------------------------------------------------------------------------------------------------|----------------|-------|-------|------|----------|------|------|------|--|
|                                                                                                                                     | LEVEL I        |       |       |      | LEVEL II |      |      |      |  |
|                                                                                                                                     | BT             | PCWT  | NDLT  | MSLT | BT       | PCWT | NDLT | MSLT |  |
| *Completion, with a passing grade of at least 2 years of engineering or science study at a university, college, or technical school | 2              | 16    | 8     | 28   | 3        | 12   | 6    | 16   |  |
| **High school graduation, diploma or its equivalent                                                                                 | 3              | 24    | 12    | 40   | 4        | 16   | 8    | 24   |  |
| ***Grammar school graduation, or demonstrated proficiency, or additional training                                                   | 2              | 96    | 48    | NA   | 4        | 80   | 40   | NA   |  |
| WORK TIME EXPERIENCE (MONTHS)                                                                                                       |                |       |       |      |          |      |      |      |  |
| All educational levels as listed above                                                                                              | - No.<br>2 Hr. | 1 1/2 | 1 1/2 | 4    | 1/2      | 4    | 4    | 6    |  |

|                                             |                                    |
|---------------------------------------------|------------------------------------|
| NA = Not applicable                         | PT = Radiographic testing          |
| BT = Bubble Test                            | MT = Magnetic Particle testing     |
| PCWT = Pressure Change/<br>Measurement Test | UT = Ultrasonic testing            |
| NDLT = Halogen Diode Leak Test              | PT = Liquid Penetrant testing      |
| MSLT = Mass Spectrometer Leak Test          | ET = Eddy Current testing          |
|                                             | NRT = Neutron Radiographic Testing |

Asterisks refer to the Recommended Training Course Tables

|        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|--------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| NOTES: | Training shall be as outlined in the employer's written practices.<br>For level II certification, the experience shall consist of time at Level I and Level II as a trainee and the hours of training required for Level I and Level II in total shall apply.<br>Credit for experience may be gained simultaneously in two or more disciplines. The candidate must spend at least 25% of his work time on each discipline for which experience is being claimed. |
|--------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

and Experience  
Minimum Levels

Table 31-6-1 Recommended Training and Experience Minimum Levels



criteria:

- Graduate of a four-year accredited engineering or science college or university with a degree in Engineering or Science plus one year's experience in nondestructive testing in an assignment comparable to that of an NDT Level II in the applicable test method. If the college or university degree is issued in nondestructive testing the one year's experience requirement can be reduced to six months.
- Completion with a passing grade of at least two years of engineering or science study at an accredited university, college, or technical school plus two years' experience as a certified NDT Level II in the applicable test method, or
- Four years' experience as a certified NDT Level II in the applicable test method, or
- When the individual is qualified by examination, the above requirements may be partially replaced by experience as a certified NDT Level II in other test methods as defined in the employer's written practice.

ANSI N45.2.6 Prerequisites for Education, Training and Experience

ANSI N45.2.6 gives prerequisites for education and experience and charges the employer with establishing policies for crediting related training or other qualifying factors such as qualification in similar inspections and tests by other employers. The prerequisites are as follows:

- Level I
- High School Graduate plus One year experience in Quality Assurance including testing or inspection (or both) of equivalent construction and installation activities.

- Level II
- High School Graduate plus; Four years experience in testing or inspection (or both) of power plants, nuclear plants, heavy industry or other similar equipment or facilities, or
- Graduate of a four year accredited university, engineering or science college plus; at least two years of experience in Quality Assurance including testing or inspection (or both) of equivalent construction and installation activities.
- Level III
- High School Graduate plus; Ten years experience in general Quality Assurance or engineering of equivalent manufacturing construction and installation activities. Five years of this experience is required in Quality Assurance, including testing or inspection (or both) of equivalent manufacturing, construction and installations activities. At least two years of the ten years of experience must be involved with nuclear facilities. in lieu of the two year requirement, sufficient training to acquaint the individual thoroughly with the safety aspects of a nuclear facility will suffice, or
- Graduate of a four year accredited university, engineering or science college plus; Five years experience in Quality Assurance, including testing or inspection (or both) of equivalent manufacturing, construction and installation activity. At least two years of this experience should be associated with nuclear facilities; or sufficient training to acquaint the individual thoroughly with the safety aspects of a nuclear facility will suffice.

### Certification Examination

When the employee has met the physical, educational, training and on-the-job experience requirements, a certification examination is given to the employee. Successful completion of the examination provides basis for the employer to issue a certificate of qualification to the employee. These examinations for Level I and II qualifications are administered by or under the direction of the Level III person in the inspection or test method for which qualification is sought. Examination of Level III qualifications are administered by a person authorized by the employer's written practice. SNT-TC-1A gives specific guidelines for these examinations and ANSI N45.2.6 requires use of the guidelines given by SNT-TC-1A.

It is worthy to note that an individual loses his/her certification upon leaving the employer who performed the certification. However, certification can be re-established with a new employer by measuring up to the new employers established practice.

In addition, certification examinations are not restricted to quality assurance/quality control personnel at a nuclear plant. It is often necessary to certify other persons such as maintenance personnel and supervisors to ANSI N45.2.6 because they actually perform surveillance tests, in-service inspection tests, and pre-operational tests. Furthermore these individuals are also involved in approving these test procedures.

The certification examination consists of a two part written test and a practical test. These tests have the following scope:

- Written test, Part I - General - the general test covers the basic test principles relative to the applicable inspection or test method. The employer's

written program must define the extent of this test. This portion is frequently labeled the theory test.

- Written test, Part 2 - Specific - The specific test covers the equipment, operating procedures, and test techniques that the employee may encounter in the inspection or test activities assigned. This portion is frequently labeled the technical test.
- Practical Test - The practical test requires the employee to demonstrate to the satisfaction of the examiner that the candidate is familiar with and can operate the necessary inspection or test equipment and analyze the inspection or test results to the degree required by the level of qualification.

#### Grading Method for Examinations

The certification examinations are scored using a percentile weight factor for each part. The total of the percentile weight factors must equal 1.0. The score in percentage of correct answers of each part is multiplied by the percentile weight factor and the three products are added to obtain the composite grade as shown in Equation 31-6-1.

#### Equation 31-6-1

$$G_c = (G_g \times W_g) + (G_s \times W_s) + (G_p \times W_p)$$

where  $G_c$  = Composite grade

$G_g$  = Actual grade from general examination in percent

$W_g$  = Percentile weight of general examination

$G_s$  = Actual grade from specific examination in percent

$W_s$  = Percentile weight of specific examination

Gp = Actual grade from practical examination in percent

Wp = Percentile weight of practical examination

**Example**

**Problem:** Compute the composite grade obtained by the candidate

**Given:**

Assigned percentile weight factors:

General examination = .3

Specific examination = .2

Practical examination = .5

Scores obtained by candidate:

General examination = 87%

Specific examination = 72%

Practical examination = 90%

**Solution:**

$$\begin{aligned} Gc &= (87\% \times .3) + (72\% \times .2) + (90\% \times .5) \\ &= 26.1\% + 14.4\% + 45\% \\ &= 85.5\% \end{aligned}$$

Minimum grades for certification are specified for both the composite grade and grade of each examination. This is based on the premise that a candidate should have an adequate overall expertise and specific expertise in theory, technical requirements, and performance of the inspection or test. Minimum acceptable grades are listed in Table 31-6-2.



Table 31-6-2  
Minimum Acceptable Grades

| Qualification Level | Examination Grades |        |        |        |
|---------------------|--------------------|--------|--------|--------|
|                     | Part 1             | Part 2 | Part 3 | Part 4 |
| I and II            | 70%                | 70%    | 70%    | 80%    |
| III                 | 80%                | 80%    | 80%    | 90%    |

Comparison of Levels of Qualification with Project Functions

The specific inspection and test activity assigned to an individual determines the level of qualification that the individual must possess. Tasks associated with inspections and tests are grouped into categories which parallel the three levels of qualification described earlier in this module. The individual who is assigned those tasks falling into the Level I grouping must qualify as Level I. Likewise, the individual who is assigned those tasks falling into Level II or III groupings must qualify as Level II or Level III. Typical tasks and their associated minimum level of qualification are given in Table 31-6-3. Qualified persons can perform any of the tasks in the levels lower than that qualified for.

Certification Records

Each employer retains records of personnel certifications including bases for the certifications. These records may be a single record format containing all required information or they may be a collection of various records which collectively contain required information. Minimum information contained by these records is:

- name of certified individual
- level of certification and category of inspection or test qualified for

- educational background and experience of the individual
- statement indicating satisfactory completion of training or reasons for waiver of training
- results of physical tests
- individual and composite grades from all examinations
- percentile weights assigned to each examination
- date of certification
- date of employment
- signature of person authorized to issue the certification.

Table 31-6-3

Minimum Levels of Qualification for Project Functions

| Project Function                                               | Level<br>I | Level<br>II | Level<br>III |
|----------------------------------------------------------------|------------|-------------|--------------|
| Approve inspection and test procedures                         |            |             | x            |
| Designate the particular test method & techniques              | x          |             |              |
| Implement inspection & test procedures                         | x          |             |              |
| Record inspection and test results                             |            | x           |              |
| Evaluate inspection and test results                           |            | x           |              |
| Supervise or monitor the performance of Level I persons        |            | x           |              |
| Report inspection and test results & the acceptability thereof |            | x           |              |



## EXERCISES

The following activities reinforce the information presented in this module.

1. Obtain from the instructor a copy of a company's written practice for the certification of personnel and compare it with the content of this module. Note additions or omissions of the written practice and for each, offer rationale on its purpose. Follow the procedure outlined in the Procedures section of this module to assist you in completing this exercise.
2. Determine status of your compliance with prerequisites for qualification as a Level II inspector as contained in this module. Using the Procedures section of this module determine your present status and additional training required to meet the Level II training prerequisites.
3. Describe the applicable and interrelationship of ANSI N45.2.6 and SNT-TC-1A which govern the certification and qualification of quality control inspectors.
4. Describe the capabilities of individuals qualified to Level I, II and III inspectors.
5. Describe the examination prerequisites for qualification including naming the types of examinations, their purpose and minimum acceptable grades.
6. List at least six types of information required for personnel certification records.



## MATERIALS

The following materials are required for this module.

1. A sample of actual filled out certification forms
2. A sample of actual personnel experience records.
3. A list of the types of training available by an employer for Levels I, II and III inspectors.
4. Procedures followed by a given company in re-establishing the certification of a new employee who was originally certified elsewhere.
5. Copy of ANSI N45.2.6.
6. Copy of SNT-TC-1A.



## PROCEDURES

1. Exercise 1 of this module requests that a comparison be made between a particular company's written practice for the certification of personnel and to compare it with the content of this module.

In order to make this comparison it is suggested that the following be obtained from a local company:

- a. A sample of actual filled out certification forms, (if possible).
- b. A sample of actual personnel experience records, (if possible).
- c. A list of the types of training available by the employer.
- d. Procedures followed by the given company in re-establishing the certification of a new employee who has been certified as an inspector in another company.

In addition to this, copies of ANSI N45.2.6 and SNT-TC-1A will be helpful along with the module notes to make this comparison.

2. Exercise 2 of this module requests that you make a determination of your own status in complying with the prerequisites for qualification as a Level II inspector. In order to do this you will need to do the following:
  - a. Make the determination by first extracting from this module the physical and educational and training prerequisites for Level II.
  - b. List your training and experience based on completion of the curriculum in which you are enrolled and on prior experience.
  - c. Compare your listing with Table 31-6-1 of this module and determine your status in meeting the recommended minimum hours of training.



**DATA TABLE**

Not applicable.

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## REFERENCE MATERIALS

- NRC, Regulatory Guide 1.58, Qualification of Nuclear Power Plant Inspection, Examination, and Testing Personnel, U.S. Nuclear Regulatory Commission, 1973
- ASME, Qualifications of Inspection, Examination, and Testing Personnel for the Construction Phase of Nuclear Power Plants, ANSI N45.2.6. The American Society of Mechanical Engineers, 1973
- ASNT, Recommended Practice for Personnel Qualification and Certification in Nondestructive Testing, SNT-TC-1A, American Society for Nondestructive Testing, 1975
- Juran, J.M., Quality Control Handbook. McGraw-Hill, 1974



# TEST

Answer the following questions as either true or false:

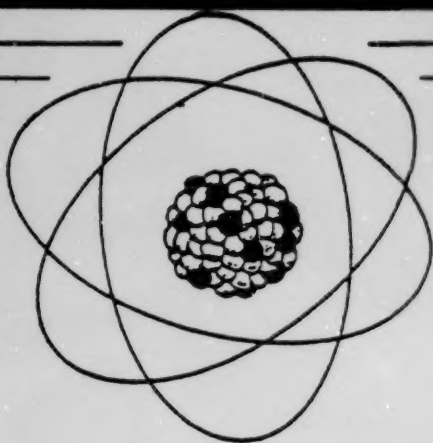
- \_\_\_\_\_ 1. The Nuclear Regulatory Commission recognizes two standards as describing the acceptable requirements for the certification of quality control inspectors: SNT-TC-1A, "Personnel Qualification and Certification in Nondestructive Testing" and ANSI N45.2.6, "Qualification of Inspection, Examination, and Testing Personnel for the Construction Phase of Nuclear Power Plants".
- \_\_\_\_\_ 2. ANSI N45.2.6 applies to the qualification of persons who have responsibilities for radiography, magnetic particle, ultrasonic, liquid penetrant, eddy current, neutron radiography, and leak testing.
- \_\_\_\_\_ 3. SNT-TC-1A applies to all other quality control inspections and tests.
- \_\_\_\_\_ 4. Both SNT-TC-1A and ANSI N45.2.6 requires the employer to establish a written practice which describes the criteria to be met by individuals for certification to one of three levels.
- \_\_\_\_\_ 5. Employer's written practices stipulate qualification criteria in three areas: (1) starting salary, (2) work - related hobbies, (3) previous military experience.
- \_\_\_\_\_ 6. Levels of qualification in order of ascending requirements are III, II, and I respectively.
- \_\_\_\_\_ 7. Level I qualification requires the individual to be capable of (1) planning and supervising inspections and tests, (2) preparing, reviewing, or approving inspection and test procedures, (3) evaluating the adequacy of inspection or test activities, (4) organizing and reporting results of inspections or tests, and (5) certifying the validity of inspection and test results.

- \_\_\_ 8. Level II qualification requires the individual to be capable of (1) supervising or monitoring others who perform inspections or tests, (2) calibrating, or determining validity of calibrations, of measuring and test equipment (3) planning and setting-up tests or inspections, and (4) determining the validity of test results.
- \_\_\_ 9. Level III qualification requires the individual to be capable of (1) demonstrating proper use of tools and equipment, (2) demonstrating familiarity with calibration controls, and (3) verifying that required equipment is in proper operating condition.
- \_\_\_ 10. Candidates are certified based on their compliance with the prerequisites associated with (1) physical criteria, (2) educational and experience criteria, and (3) examination criteria.
- \_\_\_ 11. Physical prerequisites are comorized of (1) near distance visual acuity, (2) color discrimination, and (3) Being able to run the mile in 4.5 minutes.
- \_\_\_ 12. Prerequisites for educational background and experience are considered in composite form whereby on-the-job experience prerequisites decrease as educational level and specific training increases.
- \_\_\_ 13. Prerequisites pertaining to the examinations require the candidate to achieve acceptable grades on a three part examination: (1) general, (2) specific, and (3) practical.
- \_\_\_ 14. For Levels I and II qualification, minimum acceptable examination grades are 80% on individual examinations and 70% for the composite grade.
- \_\_\_ 15. For Level III qualification, minimum acceptable examination grades are 80% on individual examinations and 90% for the composite grade.

\_\_\_\_\_ 16. Composite grades are calculated by adding the products of individual grades time percentile weights plus adding on an additional 5 percent if the individual is a war veteran.

Answer the following essay questions.

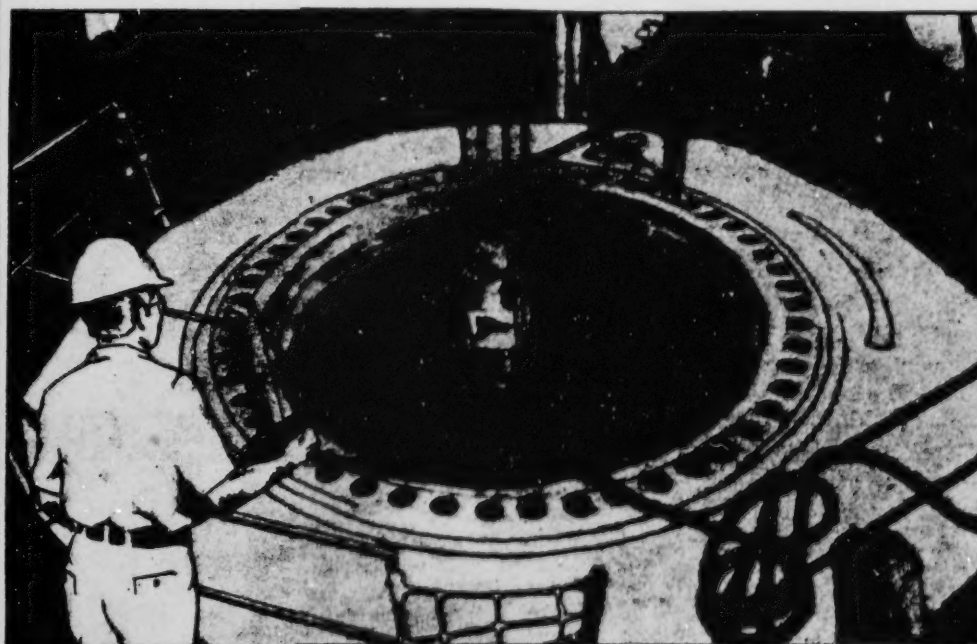
1. Briefly explain the application and interrelationship of ANSI N45.26 and SNT-TC-1A.
2. What is the purpose of an employer's written practice on personnel certification.
3. Briefly describe the capabilities of individuals qualified to Levels I, II, III inspectors.



# NUCLEAR TECHNOLOGY

## MODULE 31-7

### AUDITING FOR QUALITY ASSURANCE



## COURSE 31 QUALITY ASSURANCE PRACTICES



CENTER FOR OCCUPATIONAL RESEARCH AND DEVELOPMENT

4800 LAKEWOOD DRIVE WACO, TEXAS





## COURSE MODULES

### COURSE 31      QUALITY ASSURANCE PRACTICES

- MODULE 31-1      Overall Quality Assurance Program
- MODULE 31-2      Vendor Qualification
- MODULE 31-3      Receiving Inspection
- MODULE 31-4      Identification, Storage and Handling  
                         of Components, Parts and Materials
- MODULE 31-5      Non-Conforming Materials
- MODULE 31-6      Certification and Qualification of  
                         Quality Control Inspectors
-  MODULE 31-7      Auditing for Quality Assurance
- MODULE 31-8      Document Handling, Storage and  
                         Retrieval for Quality Assurance

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## INTRODUCTION

The Nuclear QA/QC technician serves an important role in quality assurance audits. The technician assists in planning the overall audit system, prepares audit check lists, serves as an audit team member, assists in writing audit reports and reviewing replies thereto, and verifies the implementation of corrective action. This module describes the key features of an audit system and offers practice in carrying out these tasks of the technicians.

Quality Assurance Audits are required by 10CFR50, Appendix B. Even prior to the existence of this requirement, the value of audits was long recognized and audit systems were employed by many companies. If conducted properly, audits are a valuable management tool for increasing the effectiveness of a quality assurance program.

One can logically assume that managers strive to ensure that activities within their purview are carried out properly and efficiently. The manager establishes plans, resources and methods toward this purpose. How, then, can audits be useful? Two basic premises give insight to the answer: (1) A fresh look by persons not directly responsible for the activity can identify problems that were not previously sensed or considered worthy of action, and (2) Everything under control tends to go toward a state of uncontrol.



## MODULE PREREQUISITES

The student shall have completed all previous modules of Course 31.



# OBJECTIVES

Upon completion of this module, the student/trainee can:

1. Match codes and standards to audits.
2. State five objectives of the quality assurance audit system.
3. Describe the organizational relationship between auditors and the activity to be audited and offer rationale for the validity of this relationship.
4. Briefly describe the basis of qualification of auditors.
5. Briefly describe the basis of qualification of lead auditors.
6. Define internal and external audits.
7. State seven essential elements of the audit system and describe the basis for considering each element to be essential.
8. Describe how suppliers are selected for external audits.
9. Describe how subjects are selected for internal audit.
10. Name and discuss at least three factors considered in establishing the schedule for audits.
11. Name and discuss three major tasks associated with preparation for a specific audit.
12. Name and discuss three major tasks associated with performance of a specific audit.
13. Describe the types of information given by an audit report.
14. Describe the follow-up actions by the audited organization and the auditing organization.
15. Demonstrate the ability to plan for, conduct, and report an audit.



## NOTES TO INSTRUCTOR

Advance preparation is required for the activities suggested by this module. For Procedure #1, copies of companies' procedures for quality assurance audit programs are necessary. Copies may be obtained from nearby nuclear industries such as utilities, construction contractors, and suppliers. For Procedure #2, local activities need to be selected to serve as audit subjects. Suggested activities are laboratory activities within the curriculum of the students/trainees.



## SUBJECT MATTER

### SOURCE OF AUDIT REQUIREMENTS

#### Federal Regulation

Criterion XVIII of Appendix B to Title 10 Code of Federal Regulation Part 50 (10 CFR 50) requires that an audit program be established and implemented. This criterion reads as follows:

A comprehensive system of planned and periodic audits shall be carried out to verify compliance with all aspects of the quality assurance program and to determine the effectiveness of the program. The audits shall be performed in accordance with written procedures or check lists by appropriately trained personnel not having direct responsibilities to the areas being audited. Audit results shall be documented and reviewed by management having responsibility in the area audited. Follow-up action, including reaudit of deficient areas, shall be taken where indicated.

The Nuclear Regulatory Commission reviews applications for Construction Permits and Operating Licenses for nuclear power plants against this criterion. The applicant is required to describe the audit program employed by the utility and provisions for requiring audit programs by suppliers to the utility.

#### Regulatory Guides and Standards

Industrial societies have developed standards which give guidelines on methods for complying with Criterion XVIII of Appendix B to 10 CFR 50. The applicability of these standards is described by Regulatory Guides issued by the Nuclear Regulatory Commission. As illustrated in



Figure 31-7-1, different guides and standards apply to the Design and Construction Phases as compared to the Operations Phase.

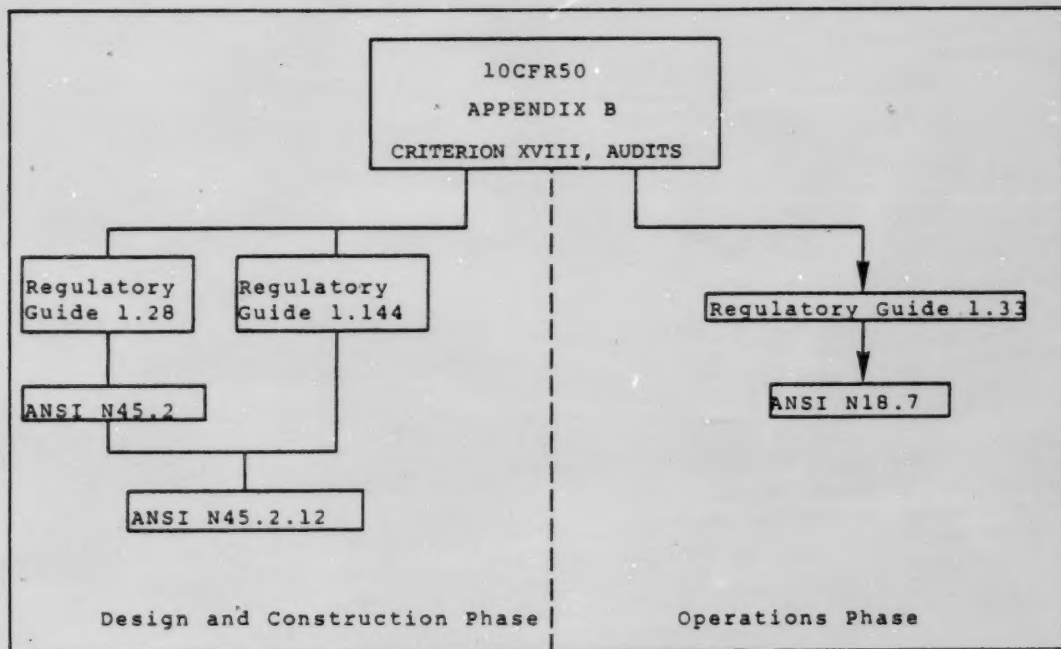


Figure 31-7-1. Regulations and Standards Audits

#### Design and Construction Phase Audit Requirements

NRC's Regulatory Guide 1.28 recognizes ANSI N45.2, "Quality Assurance Program Requirements for Nuclear Power Plants," as a satisfactory standard for the quality assurance program, including audits, for the Design and Construction Phase. Section 19 of ANSI N45.2 describes requirements for the audit program. A supplementary standard, ANSI N45.2.12 pertains specifically to audits and gives considerably more detailed requirements. NRC's Regulatory Guide 1.144 recognizes ANSI N45.2.12 as an

acceptable standard for quality assurance audits during the Design and Construction Phase and for audits of suppliers during the operations phase.

#### Operations Phase Audit Requirements

NRC's Regulatory Guide 1.33 recognizes ANSI N18.7, "Administrative Controls and Quality Assurance for the Operational Phase of Nuclear Power Plants", as a satisfactory standard for the quality assurance program, including audits, for the Operations Phase. Section 4 of this ANSI N18.7 gives requirements for an audit program. NRC's Regulatory Guide 1.144 recommends application of ANSI N18.7 for audits at the power plant site during operation and permits application of ANSI N45.2.12 to audits of off-site suppliers.

While two standards apply to audits, there is so much similarity in their requirements that distinguishment between the standards is unnecessary. Therefore, this module covers the collective requirements of the two standards without attempting to distinguish between them.

### AUDIT PROGRAMS

#### Definitions

The terms auditor, lead auditor, and audit are defined as follows:

- Auditor - Any individual who performs any portion of an audit, including Lead Auditors, technical specialists, and others such as management representatives and auditors-in-training.
- Lead Auditor - An individual qualified to organize and direct an audit, report audit findings, and evaluate corrective action.
- Audit - A documented activity performed in accordance

with written procedures or checklists to verify, by examination and evaluation of objective evidence, that applicable elements of the quality assurance program have been developed, documented, and effectively implemented in accordance with specified requirements. An audit should not be confused with surveillance or inspection for the sole purpose of process control or product acceptance.

#### Objectives of the Audit Program

Each company's audit program is described by written policies, plans, procedures or instructions. The written audit program description provides for the accomplishment of five objectives. These objectives of the audit program are:

- To determine that a Quality Assurance Program has been properly developed and is documented in accordance with all required regulations, codes and standards. This objective is aimed primarily toward Criterion II of 10CFR50, Appendix B, which requires a documented program that meets all applicable criteria of Appendix B.
- To ensure the documented Quality Assurance Program has been implemented by conducting examinations and evaluations of objective evidence. This objective is aimed primarily toward criterion I of 10CFR50, Appendix B, which requires each organization to execute the documented Quality Assurance Program.
- To determine the effectiveness of the Quality Assurance Program. This objective is aimed toward ensuring that the intent of 10CFR50, Appendix B, is met, i.e., that an adequate Quality Assurance Program exists.
- To identify any deficiencies or nonconformances of

the Quality Assurance Program. This objective sometimes results in auditors being labeled as the "bad person" or "spy". However, for improvements to be made, deficiencies must be identified. In this objective, the term deficiency refers to failure to develop, document or implement any portion of the Quality Assurance Program. The term nonconformance refers to anything that renders the quality of plant hardware items as unacceptable or unknown. These two terms are used to distinguish administrative problems (deficiency) from technical problems (nonconformance). A deficiency can be a nonconformance when the failure of the Quality Assurance Program causes an action that is detrimental to hardware quality or omits an action that is needed to determine hardware quality.

- To ensure any deficiencies in a Quality Assurance Program are corrected. This objective is the logical extension of the prior objective. It does not pertain specifically to nonconformances because any nonconformance noted would be handled via the nonconforming material control system described by Module 31-5 of this course. The nonconforming material control system is subject to audits and such audits can be relied upon to ensure that nonconformances are properly corrected.

#### Independence of Audit Personnel

All persons selected to serve on quality assurance audit teams are selected and assigned to ensure that each team member does not have direct responsibility for the performance of the activities which they will audit. Further, persons having direct responsibility for the performance of the activities being audited can not be in-

volved in the selection of audit team personnel. Direct responsibility refers to the performing, supervising and managing an activity that is to be audited. Independence from the activity to be audited ensures better objectivity in that the auditor provides a "fresh look" and does not have to defend the practices employed within the activity.

To illustrate independence of auditors, Figure 31-7-2 identifies possible combinations of audit team members for a hypothetical organization.

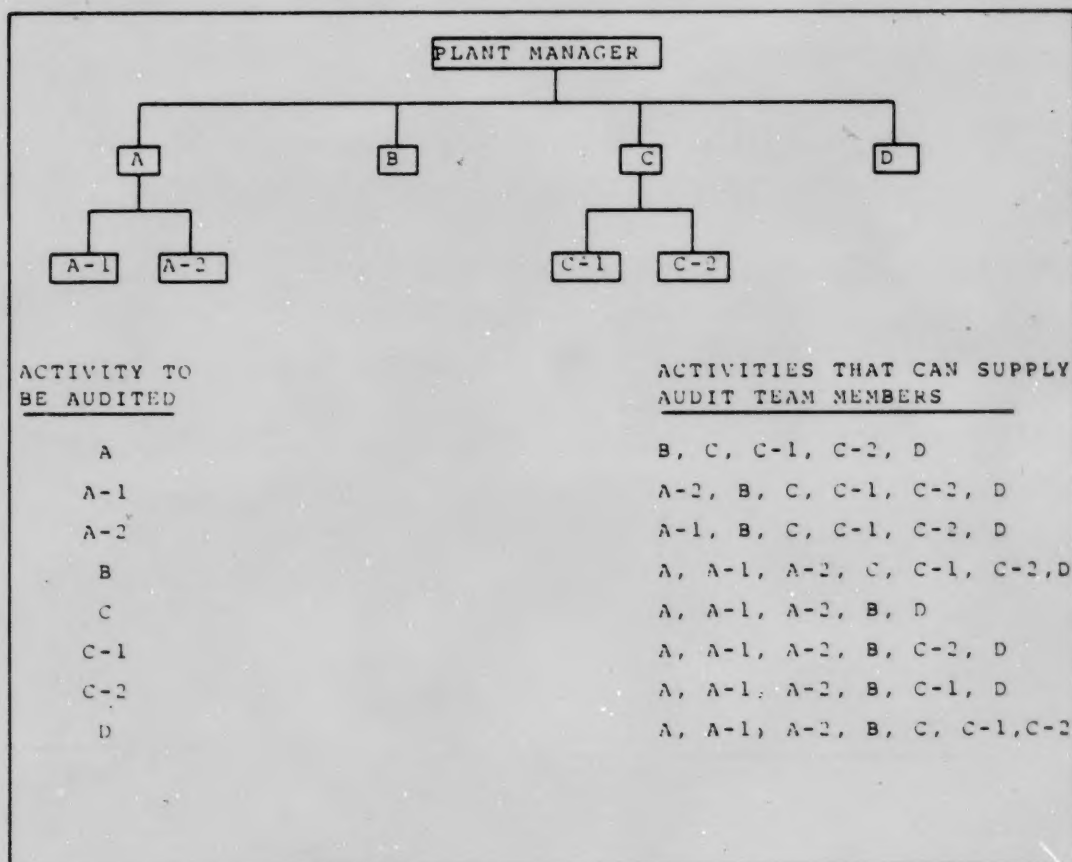


Figure 31-7-2. Audit Team Selection



### Qualification of Auditors and Lead Auditors

Each company is responsible for establishing the qualification requirements for audits. Such qualification requirements ensure that personnel selected for auditors and lead auditors have the experience and training commensurate with the scope, complexity and special nature of the activities to be audited. Put simply, auditors should be knowledgeable on the audit subject and experienced as auditors.

Auditors are qualified by training and on-the-job experience. Training of auditors consists of (1) orientation training on quality assurance systems and (2) specialized training in auditing techniques. The orientation-training provides a working knowledge and understanding of quality assurance regulations and standards and the company's quality assurance program. Specialized training provides knowledge and develops skills in auditing techniques. Knowledge and understanding are provided on audit objectives, essential elements, and procedures for planning, performing, and reporting of quality assurance audits. Skills are developed in examining, questioning, evaluating, documenting, and closing out specific audit items. On-the-job experience consists of audit performance under the direct supervision of a lead auditor. Training, guidance, and counseling is provided by the lead auditor on planning, performing, reporting and followup actions associated with audits.

Qualification of lead auditors is based on (1) education and experience, (2) communications skills, (3) training, (4) audit participation, and (5) examination. Each of these are described as follows:

- Education and experience - ANSI N45.2.23 specifies a point system for education and experience. Point credits are allotted for level of education; technical experience in engineering, manufacturing,

construction, operation, or maintenance; certificates of competency in engineering, science, or quality assurance specialties which are issued and approved by state agency or national professional or technical society; and performance within the company's organization. A minimum of 10 points total from these categories is necessary for qualification.

- Communications skill - Oral and written communications skills are extremely important for the lead auditor in both directing the audit and communicating with the audited organization. The company is required to attest in writing that their lead auditors possess effective oral and written communications skills.
- Training - Lead auditor training consists of five parts: (1) regulations and standards, (2) structure of quality assurance program, (3) audit planning, (4) auditing techniques, and (5) on-the-job training. Training provisions for these five areas are listed in Table 31-7-1.
- Audit participation - The prospective lead auditor is required to have participated in at least five quality assurance audits within the three years prior to the date of qualification. At least one of the audits must be a nuclear quality assurance audit and performed within one year prior to the date of qualification.
- Examination - The prospective lead auditor must pass an examination which evaluates the candidate's comprehension of and ability to apply the body of information addressed by the five areas of training. The examination may be oral, written, practical or combination thereof.

Table 31-7-1

| Training of Lead Auditors               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|-----------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Subject                                 | Objectives                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Regulations and Standards               | To provide a knowledge and understanding of quality assurance regulations and standards.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Structure of Quality Assurance Programs | To provide a knowledge and understanding of quality assurance programs as a whole and applicable elements such as organization; design control; procurement document control; procedures and drawings; document control; control of purchased materials, equipment, and services; identification and control of materials, parts, and components; control of special processes; test control; control of measuring and test equipment; handling, storage, and shipping; inspection, test and operating status; nonconforming materials, parts, or components; corrective action; quality assurance records; audits; and quality information feedback. |
| Audit Planning                          | To provide knowledge and develop skills in audit planning associated with scheduling, preparation, performance, reporting, and followup of audits.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Auditing Techniques                     | To develop skills in audit techniques of examining, questioning, evaluating, reporting, followup, and closure.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| On-the-Job                              | To provide practical experience in audit planning and auditing techniques.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |

### Types of Audits

There are two basic types of audits: internal and external. Internal audits are audits of those portions of an organization's QA program retained under its direct control and within its organizational structure. External audits are audits of those portions of an organization's QA program not retained under its direct control and not within its organizational structure. In most cases, internal audits are internal to a company and external audits address suppliers to that company. However, the definitions of these audits also pertain to different organizational entities within a parent company.

### External Audits

External audits are applied to suppliers. As described in Module 31-1, a pyramid of hundreds of suppliers can be involved in the design, construction and operation of a nuclear power plant. Each company that contracts for items and services establishes an external audit program to evaluate the quality assurance program employed by the subcontractor. Module 31-1 pointed out that the extent of quality assurance requirements imposed on a subcontractor is proportional to the significance of the contracted item or service on safe plant operations. Therefore, the extent of auditing of subcontractors also varies on the same basis. Unless the supplier's items or services are accepted solely by receiving inspection, each supplier is audited either annually or triannually.

External audits are performed prior to placement of a contract (preaward) or after placement of a contract (postaward).

The preaward audit is performed when there is no or little prior experience with the subcontractor and the contract to be placed involves items or services that are

very important to safe plant operation. This audit determines if the subcontractor is capable of delivering quality items or services. Placement of the contract is contingent on the findings of the preaward audit.

The postaward audit is performed to determine that the subcontractor is producing quality items or services. This type of audit is needed for those items and services that are too complex to determine quality by inspection alone. Such items and services typically include those by nuclear steam system suppliers, architect-engineers, and component suppliers described in Module 31-1. The other types of suppliers described in Module 31-1 may be audited dependent on the significance of their product to safe plant operation.

#### Internal Audits

Internal audits are conducted by an organization to determine that its own quality assurance program is adequate and effective. The internal audit program addresses each applicable criteria of 10CFR50, Appendix B and other applicable regulatory requirements. The applicant for construction permits and operating licenses for nuclear power plants and all tiers of contractors to the applicant can be expected to implement an internal audit program.

#### Essential Elements of the Audit System

There are seven essential elements of a quality assurance audit system. Audit systems which contain these essential elements have little difficulty in meeting the five objectives described earlier. These essential elements are:

- A management policy statement which establishes organizational independence and authority of the auditors and commits the organization to an audit



system meeting the requirements of governing regulations and standards.

- Commitment to the necessary staffing, funding and facilities to implement the audit system.
- Identification of responsibilities for the audit system.
- Provisions for audit teams to have reasonable and timely access to the facilities, documents and personnel necessary in the planning and performance of audits.
- Provisions for reporting on the effectiveness of the Quality Assurance Program to the responsible management of both the audited and auditing organizations.
- Provisions for access by audit teams to levels of management of both the auditing and audited organizations that have responsibility and authority to assure corrective action.
- Provision for the verification of effective corrective actions on a timely basis.

The first essential element, management policy statement, is issued by a senior level of management (President or Vice-President). The policy statement is normally the introductory part of the audit system procedure although it could be issued separately. This statement serves to announce to the entire organization that the company desires to have an effective audit system and that all departments are expected to support the audit system.

The second essential element, commitment to resources, takes into consideration that audits cost time and money and do not directly produce product. It is an overhead cost. Its worth is in its ability to detect and correct conditions that are likely to cause nonconformances. Since nonconformances represent losses, including

high dollar losses, it is possible that prevention of a single, large cost nonconformance will pay for a year's worth of audits. However, it takes effective audits to achieve overall cost savings. This essential element is based on the need to invest labor hours, funding and facilities to make it possible for effective audits to be performed. It is also based on the premise that a definite expenditure for audits is warranted just to obtain confidence in the Quality Assurance Program.

The third essential element, identification of responsibilities, delineates the authorities, responsibilities and organizational independence for each portion of the audit system. Most companies assign overall audit responsibility to their Quality Assurance Managers. This essential element gives to the manager the authority to have unimpeded access to other organizational entities to audit their portions of the Quality Assurance Program. It also charges audited organizations to develop effective corrective action on audit findings.

The fourth essential element, reasonable and timely access, is contained in procedures and contracts. For internal audits, provisions for access is normally included in the management policy statement given as the first essential element. For external audits, provisions are placed in the procurement documents for reasonable and timely access to the subcontractor's facilities, records and personnel. This essential element is based on the need for full and unimpeded discourse of information to permit performance of a meaningful audit.

The fifth essential element, reporting, pertains to level of reporting and nature of the report. Managers are responsible for effective implementation of quality assurance activities and have the authority to change or add methods of implementation. For this reason, this

essential element provides for reporting audit results to a level within the company who can initiate actions to improve the Quality Assurance Program. Also, this essential element authorizes the lead auditor to report on the effectiveness of the Quality Assurance Program based on audit findings.

The sixth essential element, access to management is important during the performance of an audit. It permits the audit team to discuss with appropriate levels of management the approach, progress and results of the audit. It helps ensure obtaining all relevant information because management is aware of all sources of information which may be of interest to the auditors. Also it gives immediate reaction to audit findings which helps the lead auditor to report findings in proper perspective. Therefore, this essential element provides for two way communication with responsible persons such that performance of audits and understanding and correction of audit findings are improved.

The seventh essential element, verification of corrective action, gives authority and responsibility to the auditing organization to confirm that effective corrective action has been taken. For corrective action to be totally effective, it must be timely to avoid the generation of nonconformances in the interval between detection of a deficiency and implementation of corrective action. This essential element ensures that the same independent review which found deficiencies is also applied toward corrective actions.

## AUDIT SYSTEM PLANNING AND SCHEDULING

### Scope of Planning

The audit system and each individual audit require planning in order to provide for effective results. This section describes planning of the audit system. A later section of this module describes planning of an individual audit.

The individual assigned the overall responsibility for the audit system (usually the Quality Assurance Manager) ensures adequate planning of the audit system. Such planning provides for determination of (1) what to audit, (2) approximately when to audit, (3) who will audit and (4) how audits are generally performed. The planning results in a written procedure which describes these determinations as well as assigning responsibilities for continuously making these determinations.

### What to Audit

There is an axiom within quality assurance circles that states "if it is required, it should be audited". This axiom applies to the determination of what to audit but it is tempered by the resources allocated to the audit system. There are so many requirements that it is simply impractical to audit all requirements. Therefore, those requirements most important to safe operation of the nuclear power plant receive highest priority. The audit system procedure assigns responsibility for determining what to audit.

For external audits, determination of what to audit culminates in a listing of suppliers to be audited. This listing is not static. As contracts are placed with suppliers not on the listing, a determination is made to

add or not add the supplier. Suppliers placed on the listing meet one or more of the following characteristics:

- Supplier of complex product or services
- Source and receiving inspection results indicate that the supplier has a poor or marginal quality assurance program
- Little prior knowledge of supplier performance
- Previous audit indicated need for followup audit.

For internal audits, determination of what to audit results in a listing of audit subjects by (1) quality assurance criteria or (2) organizational department.

In the former case, all of the applicable criteria of Appendix B to 10 CFR 50 serve as the audit subject list. Some organizations use the applicable eighteen criteria verbatim as the audit subject listing while others subdivide several of the criteria. Either approach results in auditing all departments within the organization who have activities within the criteria selected for audit. This offers the advantage of easily auditing the interfaces among various departments. It has the disadvantage of more frequent audits of a given department because most departments have responsibilities under many of the eighteen criteria. In the second case, a listing of each department having quality assurance activities comprises the audit subject listing. In this case, an audit of a department covers all criteria of Appendix B to 10 CFR 50 that fall within the responsibilities of the audited department. This offers the advantage of less frequent audits of a given department. It has the disadvantage of large potential for not effectively auditing the interfaces between the audited department and other departments.



### When to Audit

The audit system procedure assigns responsibility for maintaining a schedule of audits to be conducted. The schedule may project those audits planned for the next six months, next year or next several years. The schedule is not static but is adjusted as the need arises to identify when audits will be performed.

For both internal and external audits, determination of when to audit gives consideration to unique functions within the audit subject that tend to dictate when to audit. In some cases, it doesn't matter when the audit is performed. However, the following factors may dictate the audit schedule; these are considered in development and maintenance of the schedule for both internal and external audits:

- Duration of the Work Effort - If the subject to be audited is of short term effort, it must be audited early during the life of the effort.
- First of a Kind Activity - If the audit subject includes activities that are being done for the first time, it is wise to audit that subject at the onset of the first of a kind activity. This is based on historical data which indicate that more problems are associated in first-time performance of an activity than in subsequent performance of the same activity.
- Significant Changes in Organizational Responsibilities - While an activity may have been performed many times, if another organization or department is assigned responsibility for the activity, some problems can be expected to occur. Shortly after significant changes in organizational responsibilities, an audit should be conducted.
- Critical State of Activity - Within many activities there are certain scheduled tasks that are extremely

important to the successful accomplishment of the activity. When this is known, it is best to schedule the audit to coincide with these important tasks.

- Elapsed time since previous audit - Regulatory requirements require that certain audits be conducted annually or triennially. The audit schedule must provide for compliance with such commitments to the NRC.

### Who Will Audit

The audit system procedure can identify audit team members in several different ways. Two ways are most common. One is the requirement to list the lead auditor and each auditor on the audit schedule. The other is identification of a lead auditor for each audit subject and requirement for such lead auditors to select an appropriate number of auditors. In either case, persons independent of the subject to be audited are selected as discussed earlier in this module.

Selection of persons to comprise the audit team should ensure that major skills that will be needed are represented. One cannot readily audit an unfamiliar subject. Therefore, the skills associated with the audit subject should be reviewed and individuals should be selected based on their possession of these skills. As previously mentioned, both lead auditors and auditors must be qualified.

### How Audits Are Generally Performed

The audit system procedure gives policies for planning audits. These policies provide for (1) advance arrangements with the organization to be audited, (2) advance preparation by the audit team, (3) responsibilities for conduct of the audit, (4) reporting the audit and (5) followup on corrective action. Individual audits are planned within

these policies which typically are as follows:

- Audit team membership is finalized four weeks prior to the audit date to permit adequate preparation.
- Arrangements for the audit are made three weeks in advance with the organization(s) to be audited.
- Check lists are used as guidance during each audit.
- The lead auditor chairs entrance and exit meetings with the audited organization(s). These meetings arrange for specific conduct of the audit and orally present the audit findings.
- The lead auditor issues the audit report within two weeks of completion of an audit.
- Each audit report is distributed to the senior manager of the audited organization(s), the company president, the quality assurance manager and others as determined by the lead auditor.
- The lead auditor assures adequate corrective action on audit findings and schedules follow-up audits as necessary.

## AUDIT IMPLEMENTATION

### Scope

Within the policies established by the audit system procedure, each individual audit involves the following activities toward ensuring that an effective audit is performed. The four activities are (1) preparation, (2) performance, (3) reporting, and (4) corrective action follow-up.

### Preparation

Preparation of an audit involves establishing an audit plan, preparing the audit team and making arrangements with the organization(s) to be audited. The lead auditor normally has overall responsibility for preparation although each team member is usually given specific preparatory tasks. Three major tasks are involved: (1) development of a written audit plan, (2) selection and orientation of the audit team and (3) notification of the organization to be audited:

- Written Audit Plan - An individual written plan is developed for each audit to be conducted. If the subject is being audited for the first time, a new plan must be developed. If the subject has previously been audited, the prior plan is updated as necessary. The plan covers the scope of the audit, the requirements governing the audit subject, the activities to be audited, organizations to be notified of the impending audit, audit dates, and check lists. All this planning can be accomplished by the preparation of an audit agenda as illustrated by Figure 31-7-3 and audit check lists as illustrated in Figure 31-7-4.

| Agenda for ABC Power Company Quality Assurance Audit of XYZ Company |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |            |                                                                                          |              |                                                                                                             |              |                                                                                                                      |         |                                                                                               |
|---------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|------------------------------------------------------------------------------------------|--------------|-------------------------------------------------------------------------------------------------------------|--------------|----------------------------------------------------------------------------------------------------------------------|---------|-----------------------------------------------------------------------------------------------|
| I. Dates of Audit                                                   | August 8-11, 1978                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |            |                                                                                          |              |                                                                                                             |              |                                                                                                                      |         |                                                                                               |
| II. Audit Team                                                      | Mr. T. M. Audit, Manager Quality Assurance (Lead Auditor)<br>Mr. U. M. Quality, Quality Engineer<br>Ms. A. Z. Alright, Project Manager<br>Ms. U. Know, Quality Assurance Technician                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |            |                                                                                          |              |                                                                                                             |              |                                                                                                                      |         |                                                                                               |
| III. Purpose and Scope                                              | To review the adequacy of and compliance with current XYZ Company quality procedures related to work for ABC Power Company. The review will follow-up on the recommendations of the previous audit in September 1976. The review will examine work in progress, records, procedures, and quality assurance systems. Acceptance criteria are 10 CFR 50, Appendix B, and requirements of purchase orders issued by ABC Power Company.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |            |                                                                                          |              |                                                                                                             |              |                                                                                                                      |         |                                                                                               |
| IV. Outline of the Audit                                            | <p>A. Opening meeting at 8:30 A.M. on August 8, 1978. XYZ Company is requested to briefly review its present organization and assigned responsibilities for work for ABC Power Company.</p> <p>B. The Team Members' areas of interest are as follows:</p> <table> <tr> <td>I.M. Audit</td><td>Defect Prevention/Corrective Action<br/>Control of Nonconforming Material/Internal Audits</td></tr> <tr> <td>U.M. Quality</td><td>Inspection Planning<br/>Inspection Status<br/>Welding and Nondestructive Testing<br/>Heat Treatment<br/>Records</td></tr> <tr> <td>A.Z. Alright</td><td>Personnel Training/Staffing<br/>Test Control<br/>Design Control<br/>Control of Procurement Documents<br/>Drawing Control</td></tr> <tr> <td>U. Know</td><td>Subvendor Control<br/>Receiving Inspection<br/>Material Control<br/>Measuring and Test Equipment</td></tr> </table> <p>XYZ Company is requested to provide an on-call who is familiar with the particular area and adequate copies of procedures pertinent to the above areas for each Team Member. Experts will be required for each operating shift.</p> <p>C. The Team Members will be conducting the audit on each shift involved with work for ABC Power Company on August 8-11, 1978. Specific times for audit of back-shift operations will be arranged at the opening meeting.</p> <p>D. A discussion will be held at the conclusion of the visit (approximately 1:00 P.M. on August 11, 1978). A draft of the team's findings and recommendations will be reviewed at the meeting. It is requested that the following XYZ Company personnel attend this meeting:<br/>Vice President, Operations<br/>Manager, Quality Assurance<br/>Manager, ABC Company Projects<br/>Such additional personnel as XYZ Company desires</p> <p>V. Conduct of this evaluation is considered by ABC Company to be within the contractual scope of existing contracts and, therefore, does not authorize any delay in delivery or additional cost to ABC Company, either direct or indirect.</p> | I.M. Audit | Defect Prevention/Corrective Action<br>Control of Nonconforming Material/Internal Audits | U.M. Quality | Inspection Planning<br>Inspection Status<br>Welding and Nondestructive Testing<br>Heat Treatment<br>Records | A.Z. Alright | Personnel Training/Staffing<br>Test Control<br>Design Control<br>Control of Procurement Documents<br>Drawing Control | U. Know | Subvendor Control<br>Receiving Inspection<br>Material Control<br>Measuring and Test Equipment |
| I.M. Audit                                                          | Defect Prevention/Corrective Action<br>Control of Nonconforming Material/Internal Audits                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |            |                                                                                          |              |                                                                                                             |              |                                                                                                                      |         |                                                                                               |
| U.M. Quality                                                        | Inspection Planning<br>Inspection Status<br>Welding and Nondestructive Testing<br>Heat Treatment<br>Records                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |            |                                                                                          |              |                                                                                                             |              |                                                                                                                      |         |                                                                                               |
| A.Z. Alright                                                        | Personnel Training/Staffing<br>Test Control<br>Design Control<br>Control of Procurement Documents<br>Drawing Control                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |            |                                                                                          |              |                                                                                                             |              |                                                                                                                      |         |                                                                                               |
| U. Know                                                             | Subvendor Control<br>Receiving Inspection<br>Material Control<br>Measuring and Test Equipment                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |            |                                                                                          |              |                                                                                                             |              |                                                                                                                      |         |                                                                                               |

Figure 31-7-3. Sample Audit Agenda

Referring to The Sample Agenda, most plans for the audit are identified by the agenda. It identifies the scope of the audit and the major codes and standards that govern the audit subjects. It lists team members and activities to be audited by each team member. It identifies key personnel of the organization to be audited and specific dates and times for conduct of the audit.

The Lead Auditor normally consults with team members for assistance in preparing the audit agenda. During this time, individual team member assignments are finalized. Also, suggestions are made for items to be studied prior to the audit and assignments are made for preparing (or updating) audit check lists.



Check lists comprize the second portion of the written planning for a specific audit. Check lists guide the auditor during performance of the audit and help to ensure that major items are not overlooked. No matter how knowledgeable one may be on a given subject, the rapid pace of an audit in progress makes it easy to make false starts or to omit important questions. Use of a checklist can avoid these pitfalls.

There is no universally accepted format and content for checklists. Instead, the worth of a checklist is measured by its value to the user. However, in general, checklists should always include all essential elements of the subject to be audited. For example, if one were to audit a company's internal audit system, the checklist would cover all seven essential elements of an audit system described earlier in this module. In preparing specific

| SAMPLE AUDIT CHECKLIST FOR<br>INSPECTION PRACTICES                                                                                                                            |                                                                                                     |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|
| Essential Features                                                                                                                                                            | Rating<br>0 1 2 3                                                                                   |
| 1. Does the supplier's actual inspection practices, and associated record keeping practices, conform to applicable written instructions and applicable contract requirements? | <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> |
| 2. Are applicable inspection procedures available at work stations?                                                                                                           | <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> |
| 3. Do adequate provisions exist to identify to inspectors the number of locations to measure specific dimensional characteristics (e.g., lengths, diameters)?                 | <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> |
| 4. Are applicable standard tolerancing and shop practices documents such as ASME-Y-14.5 used in the performance of inspection operations?                                     | <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> |
| 5. Do all measuring and testing instruments meet specified accuracy or discrimination requirements?                                                                           | <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> |
| 6. Are all out-of-tolerance inspection results obtained during final inspection reviewed and reported as nonconformances?                                                     | <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> |
| 7. Is proper handling and lifting equipment used in the inspection area?                                                                                                      | <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> |
| 8. Is inspection area clean and free of sources of contamination?                                                                                                             | <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> |
| 9. Are required inspection data sheets reviewed for completeness and maintained by an individual other than the involved inspector?                                           | <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> |
| 10. Are final inspection results performed after all items have been measured to their final configurations?                                                                  | <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> |
| 11. Are inspection practices audited as part of the supplier's QA internal audit program?                                                                                     | <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> |
| 12. Do inspection supervisors have a listing of qualified inspectors?                                                                                                         | <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> |

Notes: 1. Lower left corner found defective for the work.  
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Figure 31-7-4. Sample Audit Check List

checks to be made for each essential element, the preparer would consider (1) requirements which must be met by the organization(s) to be audited, (2) sequence of checks, and (3) known or suspected problem areas.

- Audit team selection and orientation - The persons selected to serve on an audit team are selected with consideration given to (1) special abilities, (2) specialized technical training, (3) prior audit experience, (4) personnel characteristics, and (5) education. Selection of the lead auditor is normally made by the Quality Assurance Manager. The lead auditor, in turn, normally has responsibilities to (1) select, organize and lead the team, (2) make advance arrangements with the organization(s) to be audited, (3) plan for the conduct of the audit (normally with assistance from each team member), (4) be sure each team member understands team assignments and the overall approach, (5) represent the team during conduct of the audit, (6) ensure adequate progress and effectiveness of the audit team, (7) ensure that audit findings are valid and presented to the audited organization(s), (8) issue the audit report, and (9) ensure adequate corrective action and follow-up. Orientation for the team members by the Team Leader ensures that each team member is properly prepared prior to the audit. The orientation covers such areas as the applicable procedures, codes, policies, instructions and regulatory requirements. Also, prior audit reports of the same organization(s) and other performance data (e.g., inspection and test records) are reviewed to gain insight on suspected problem areas that should receive emphasis. Finally, attention is given to organizational structure,

interfaces and responsibilities of the activity to be audited. The end result is that each team member has a complete audit plan, an understanding of the specific assignments and a foreknowledge of who to contact during conduct of the audit. Such orientation ensures that the audit is conducted in an orderly and efficient manner.

- Notification of Impending Audit - Notification of the organization(s) that an audit is to be conducted is normally made by a letter which forwards an audit agenda or describes the scope of the audit, the lead auditor, and the dates of the audit. Specific arrangements for audit dates and focal points for communication are normally made by telephone and then confirmed by the letter.

#### Performance of an Audit

The performance section of an audit begins with arrival of the team and ends with their departure. It consists of (1) pre-audit conference, (2) audit process and (3) post-audit conference.

The pre-audit conference is a short meeting (e.g., one hour or less) upon initial arrival of the team. It is held with responsible management of the organization(s) being audited. This meeting reviews the audit agenda and specifically covers introduction of personnel, scope of the audit, presentation of the audit plan, establishment of contacts for team members, review of the audit sequence, plans for the post-audit conference, and proper channels of communications during conduct of the audit.

The audit process begins upon completion of the pre-audit meeting. The value of the planning for the audit quickly becomes apparent as conduct of the audit progresses. Specific techniques used tend to vary from one auditor to another

but in general the following techniques should be employed:

- Use check lists as a guide.
- If not already familiar with the various sites to be visited during the audit, tour briefly the sites to gain familiarity.
- Upon arrival at an area, look around and make a cursory review to see if everything appears to be in order before making the specific planned checks. Anything that appears to be unusual or out of order should be included in the samples selected for audit.
- Ensure the sequence of checks would uncover a deficiency if one exists. For example, if calibration of gages in use is the evaluation characteristic, the evaluation would not start with the gage calibration laboratory. Instead, gages on the floor would first be selected.
- Verify statements by checking objective evidence.
- Assess as checks are made, i.e., measure the value of discrete steps in terms of the requirement or organization's procedure.
- If a discrepancy appears to exist, pursue the indications to determine positively its existence and its extent.
- Have the organization confirm the existence of a deficiency. This avoids surprises later on and also permits the organization to point out any additional information that should be considered.
- Consider the potential causes of deficiencies found and pursue indicators of problems to determine their source.
- Deviate from the plan if there are indicators of problems outside the scope of the plan. (NOTE: In these instances, the auditor may elect to confirm the existence of a problem without determining its full

scope and request the organization to evaluate it and report results.)

- Periodically compare the plan against progress to determine that all areas are being audited.
- Analyze findings to determine if other or broader problems are indicated and what additional checks need to be made to confirm it. When a number of similar deficiencies are found, the organization's planning, training, supervision and internal audits are suspect.
- Ask the organization to correct minor deficiencies as you go; avoid making a management issue of minor deficiency.
- Confirm the individual who is supplying information is responsible for the item being evaluated; if not, determine who is and go to that person. People tend to answer questions on subjects for which they are not responsible; however, the auditor cannot base decisions on answers from people who are not responsible.
- Observe actual work practices, compare requirements with work practices.
- Request demonstrations if work practices cannot be observed.
- Ensure that a representative sample of evidence is selected.

In addition to the foregoing, any conditions requiring immediate corrective action are promptly brought to the attention of the manager of the audited organization. This is because the audited organization(s) is (are) responsible for identifying cause(s) and effects(s) of deficiencies. The extent of corrective action required is dependent on such causes and effects. The audit team must consider the poten-



tial for nonconformances to keep occurring until corrective action is taken. For significant findings, prompt identification to management permits corrective action to be initiated while the audit remains in progress.

Another general technique is to give specific attention to corrective actions taken in response to previous audits. It does little good to find new deficiencies if previously reported deficiencies have not been corrected.

The post-audit conference is held at the completion of the audit and prior to the team's departure. This meeting is with the audited organization's management and audit findings are presented. The lead auditor normally chairs this meeting. Audit results are reviewed and any misunderstandings are clarified. Finally, an understanding is reached on remaining actions including target dates for issuing the audit report and for replying to the audit findings.

#### Reporting of Audits

As soon as possible after completion of an audit and at least within 30 days, a written audit report is distributed to all responsible management of both the audited and auditing organizations. The report contains all important information concerning the audit such that reference to other documents is unnecessary. In this regard the report identifies:

- Team members and the key personnel contacted during the audit.
- The scope of the audit.
- A summary of the audit results, including an evaluation statement regarding the effectiveness of the Q.A. program that was audited.
- A detailed description of each Q.A. program deficiency in sufficient detail to ensure corrective action can be carried out.

- Recommendations for correcting program deficiencies or improving the Q.A. program.
- Signature of the lead auditor.

While the format of an audit report varies from one organization to another, Figure 31-7-5 illustrates a common format. The report is typically forwarded by letter to senior management of the audited organization. A sample forwarding letter is illustrated in Figure 31-7-6.

#### Follow-up

After reporting an audit, follow-up action is required by two parties. First, management of the audited organization reviews and investigates all adverse findings to determine and schedule the appropriate corrective action. The corrective action must correct specific deficiencies as well as correct the condition that caused the deficiency. The corrective actions taken or planned are described in a reply to the audit report. In the event that planned corrective actions cannot be completed within a reasonable time frame, e.g., 30 days, the reply lists scheduled dates for completion of the corrected action.

The second follow-up is performed by the lead auditor or persons designated by management of the auditing organization. This follow-up initially evaluates the adequacy of the response to the audit report. If adequate corrective action is described, the response is accepted. If not, comments on the reply are forwarded for consideration by the audited organization. Once satisfactory corrective actions have been identified and scheduled for each deficiency or area of nonconformance, the lead auditor schedules an activity to verify that corrective actions are completed on schedule. This verification may be accomplished by written communications, inspections and surveillance, or re-audits.

#### AUDIT REPORT

- I. Place:  
(organization or site audited)
- II. Dates:  
(dates of the audit)
- III. Audit Team:  
(name, title and organization of each auditor including identification of who served as the lead auditor.)
- IV. Personnel Contacted:  
(name, title and organization of key personnel contacted during conduct of the audit.)
- V. Summary and Conclusions:  
(concise description of the audit, its results and major conclusions.)
  - A. Finding #1:  
(concise statement of deficiency)
  - B. Discussion:  
(details which support the existence of the deficiency)
  - C. Recommendation:  
(action considered necessary to correct the deficiency.)

Figure 31-7-5. Sample Report Format

Letter to Vice President, Operations, XYZ Company

Dear Mr. Vice President:

This letter forwards the report of the quality assurance audit conducted by ABC Power Company on August 8 - 11, 1978.

The enclosed report identifies that, in general, XYZ Company has implemented a satisfactory quality assurance program. However, one major area of concern was noted. The Team found that records indicate that 6 of 23 tests have been conducted by unqualified personnel. Of the components represented by these 6 tests, two have been delivered to ABC Power Company. You are requested to promptly advise ABC Power Company of the actions taken to correct this serious matter.

In addition to the above major concern, the Team noted several deficiencies in need of correction. These are described by the enclosed report. I would appreciate a reply within 30 days describing the actions taken or to be taken on each of the Team's findings.

I appreciate the cooperation and support extended to the audit team.

Very truly yours,

Vice President, Power Generation  
ABC Power Company

Figure 31-7-6. Sample Audit Report Transmittal Letter

## SUMMARY

The following summarizes the major points developed in this module on auditing for quality assurance.

- \_\_\_\_\_ Nuclear utilities are required by 10 CFR 50, Appendix B to have a program of internal and external audits and to require their suppliers to have similar audit programs commensurate with the importance of suppliers' items and services to safe plant operation.
- \_\_\_\_\_ ANSI N45.2 provides requirements for the QA program for Design and Construction including audit program requirements; ANSI N18.7 provides requirements for the QA program for operation including audit program requirements.
- \_\_\_\_\_ ANSI N45.2.12 provides detailed requirements for an audit program.
- \_\_\_\_\_ The five objectives of the audit program are to (1) determine that an adequate QA program is developed and documented, (2) ensure implementation of the QA program, (3) determine effectiveness of the QA program, (4) identify deficiencies and nonconformances, and (5) ensure correction of deficiencies.
- \_\_\_\_\_ Auditors cannot have direct responsibility for the activities which they audit.
- \_\_\_\_\_ Auditors are qualified based on (1) orientation training, (2) specialized training, and (3) on the job experience.
- \_\_\_\_\_ Lead auditors are qualified based on (1) education and experience, (2) communication skill, (3) training, (4) audit participation, and (5) examination.
- \_\_\_\_\_ Internal audits are audits of those portions of an organization's QA program retained under its direct control and within its organizational structure.

External audits are preaward or post award audits of those portions of an organization's QA program not retained under its direct control and not within its organizational structure.

The seven essential elements of an audit system are (1) management policy statement which establishes independence and authority of auditors and commits the organization to an audit system, (2) commitment to necessary staffing, funding, and facilities, (3) identification of responsibilities, (4) provisions for reasonable and timely access by audit teams to facilities, documents, and personnel, (5) provisions for reporting on the effectiveness of the QA program to responsible management, (6) provision for audit team access to responsible levels of management, and (7) provision for verification of corrective action.

Suppliers are selected for external audit based on importance of their items and services to safe plant operation giving consideration to (1) complexity of items or services, (2) performance data for the supplier, (3) prior knowledge of supplier performance, and (4) need for follow-up audits.

Subjects for internal audit are selected by either (1) QA criteria applicable to the organization or (2) departments within the organization who have QA responsibilities.

Factors considered in scheduling audits are (1) duration of work effort, (2) first of kind activities, (3) significant changes in organizational responsibilities, (4) critical stages of activity, and (5) elapsed time since previous audit.



- \_\_\_\_\_ Team members are selected to obtain qualified auditors who possess skills appropriate to the activity to be audited.
- \_\_\_\_\_ Policies for performing audits provide for (1) advance arrangements with the organization to be audited, (2) advance preparation by the audit team, (3) responsibilities for conduct of the audit, (4) reporting the audit, and (5) following-up on corrective action.
- \_\_\_\_\_ Planning for a specific audit involves (1) preparation, (2) performance, (3) reporting, and (4) corrective action follow-up.
- \_\_\_\_\_ Preparation for a specific audit involves (1) development of a written audit plan, (2) selection and orientation of the audit team, and (3) notification of the organization to be audited.
- \_\_\_\_\_ Performance of a specific audit involves (1) pre-audit conference, (2) audit process, and (3) post-audit conference.
- \_\_\_\_\_ Reporting involves preparation and issuance of an audit report which identifies (1) team member and key personnel contacted, (2) scope of the audit, (3) summary of audit results including statement on the effectiveness of the QA program, (4) detailed description of deficiencies found, (5) recommendations for corrective action and (6) signature of lead auditor.
- \_\_\_\_\_ Follow-up involves (1) determination of corrective actions and reply to audit report by the audited organization and (2) verification of timely implementation of corrective action by the auditing organization.



## EXERCISES

The following exercises serve to reinforce the material presented in this module.

1. Obtain a company's procedure for performing QA audits from your instructor. Follow the instructions given in the Procedures section of this module to prepare a report of your evaluation of this procedure.
2. Perform an audit of a subject assigned by your instructor following the instructions given in the Procedures section of this module.
3. Briefly discuss the objectives of the quality assurance audit system.
4. Discuss the basis upon which QA auditors are qualified.
5. Explain the difference between internal and external audits.
6. What are the essential elements of the audit system?
7. List three factors considered in establishing the scheduling for audits.
8. What are some of the types of information presented in an audit report?
9. Discuss briefly the follow-up actions by the audited organization and the auditing organization.
10. Describe how suppliers are selected for external audits.



## MATERIALS

The following materials are required to support this module.

1. Copies of companies' procedures for audit programs (internal or external).
2. Reference copy of ANSI N45.2.12 (optional)
3. Reference copy of ANSI N45.2 and ANSI N18.7 (optional).



## PROCEDURES

1. As requested in Exercise 1 of this module, obtain from your instructor a copy of a company's procedure for QA audits. Compare the procedure with this module to determine if the procedure (a) meets the objectives of an audit program (b) contains the essential elements of an audit program, and (c) provides for preparation, performance, reporting, and follow-up for specific audits. Prepare a report of findings of this evaluation in the format suggested in this module for audit reports.
2. As requested in Exercise 2 of this module, plan for and perform an audit of a subject assigned by the instructor. Include in the planning the preparation of an audit check list, team orientation if teams are assigned, and notification to the activity to be audited. Include in the performance of the audit preaudit and postaudit conferences. Prepare a report of the audit and submit it to the instructor.



## DATA TABLE

Not applicable.



## REFERENCE MATERIALS

- GPO, Code of Federal Regulations, Title 10, Parts 0 to 199,  
U.S. Government Printing Office, 1978
- NRC, Regulatory Guide 1.144, Auditing of Quality Assurance  
Programs for Nuclear Power Plants, U.S. Nuclear Regu-  
latory Commission, 1979
- ASME, Quality Assurance Program Requirements for Nuclear  
Facilities, ANSI N45.2, The American Society of  
Mechanical Engineers, 1977
- ASME, Administrative Controls and Quality Assurance for the  
Operational Phase of Nuclear Power Plants, ANSI N18.7,  
The American Society of Mechanical Engineers, 1976
- ASME, Requirements for Auditing of Quality Assurance Programs  
for Nuclear Power Plants, ANSI N45.2.12, The American  
Society of Mechanical Engineers, 1977
- ASME, Qualification of Quality Assurance Program Audit  
Personnel for Nuclear Power Plants, ANSI N45.2.23,  
The American Society of Mechanical Engineers, 1978
- Juran, J.M., Quality Control Handbook, McGraw-Hill, 1974
- Johnson, L. Marvin, Quality Assurance Program Evaluation,  
Stockton Trade Press, Inc, 1970



# TEST

Match the source document with its description by placing the letter from the right hand column adjacent the document description in the left hand column.

| <u>Description</u>                                                                                                               | <u>Document</u>                                    |
|----------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------|
| _____ 1. Gives specific, detailed requirements for an audit system.                                                              | a. 10CFR50,<br>Appendix B                          |
| _____ 2. Provides criterion by which licensee audit programs are judged.                                                         | b. ANSI N45.2<br>c. ANSI N45.2.12<br>d. ANSI N18.7 |
| _____ 3. Standard for quality assurance programs for Operations Phase which includes audit program requirements.                 |                                                    |
| _____ 4. Standard for quality assurance program for the design and construction phase which includes audit program requirements. |                                                    |

Answer the following questions or furnish information requested as appropriate:

5. State five objectives of the QA audit program.

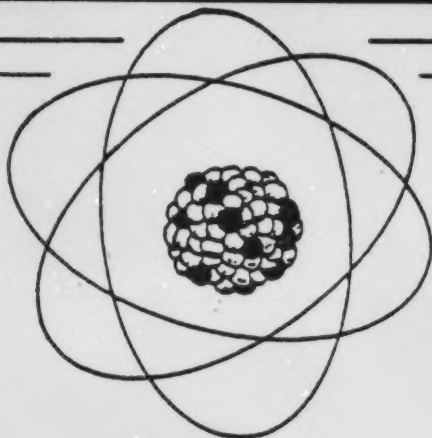
6. Describe the organizational relationship between auditors and activities being audited.



7. Briefly describe the scope of training and experience necessary for qualification as an auditor.
8. Name five factors upon which qualification as lead auditor is based.
9. Differentiate between internal audits and external audits.
10. State seven essential elements of the audit system and briefly describe the basis for each.

11. Briefly describe how a listing of suppliers subject to external audits is developed and maintained. Include four characteristics of suppliers which result in placing suppliers on the listing.
12. Briefly describe two methods of developing a listing of subjects which are to be audited by internal audits.
13. Name five factors considered in the development and maintenance of internal and external audit schedules.
14. Describe how skills and qualifications apply to the selection of audit team members.
15. Name five provisions of companies policies for the conduct of any audit.

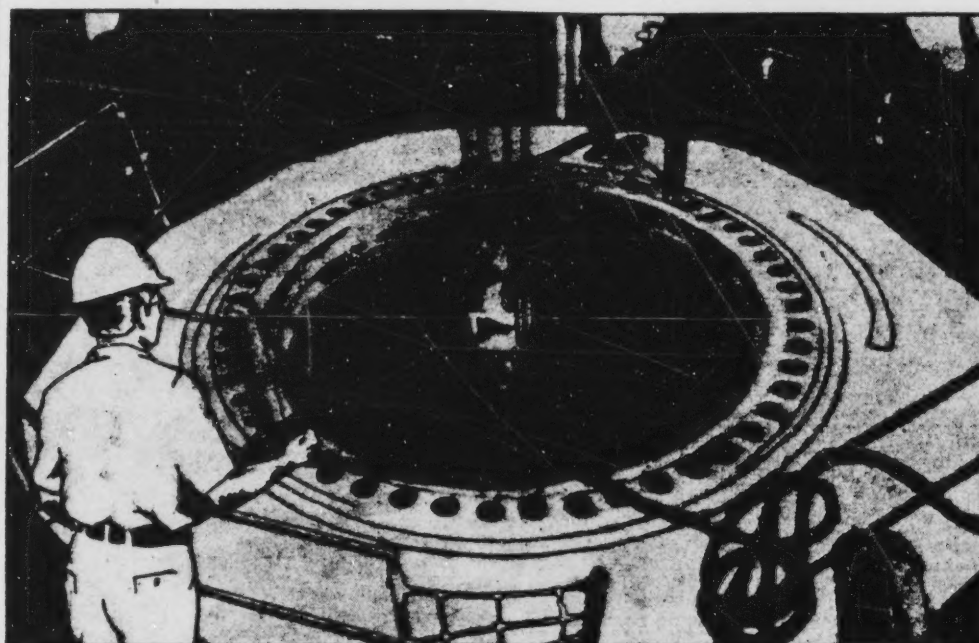
16. Name three major tasks associated with preparation for a specific audit.
17. State the purpose of audit check lists.
18. Briefly describe how an audit team prepares for conduct of an audit.
19. Briefly describe the accomplishments of a preaudit conference with the organization to be audited.
20. What should an auditor do if a very significant deficiency is found and why?
21. Briefly describe the accomplishments of a postaudit conference with the audited organization.
22. Name six types of information contained in the audit report.
23. Briefly describe the postaudit followup by the audited organization.
24. Briefly describe the postaudit follow-up by the auditing organization.



# NUCLEAR TECHNOLOGY

## MODULE 31-8

DOCUMENT HANDLING, STORAGE AND RETRIEVAL  
FOR QUALITY ASSURANCE



## COURSE 31 QUALITY ASSURANCE PRACTICES



CENTER FOR OCCUPATIONAL RESEARCH AND DEVELOPMENT

4800 LAKEWOOD DRIVE WACO, TEXAS



## COURSE MODULES

### COURSE 31      QUALITY ASSURANCE PRACTICES

- MODULE 31-1      Overall Quality Assurance Program
- MODULE 31-2      Vendor Qualification
- MODULE 31-3      Receiving Inspection
- MODULE 31-4      Identification, Storage and Handling  
                         of Components, Parts and Materials
- MODULE 31-5      Non-Conforming Materials
- MODULE 31-6      Certification and Qualification of  
                         Quality Control Inspectors
- MODULE 31-7      Auditing for Quality Assurance
-  MODULE 31-8      Document Handling, Storage and  
                         Retrieval for Quality Assurance

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## INTRODUCTION

The Nuclear QA/QC Technicians can be responsible for conducting surveys and audits of records storage to verify that required records have been collected, indexed and stored such that the records are preserved throughout their storage period. Also, the technician may have responsibilities for validating the authenticity of certain records prior to their release for storage. In either case, the technician should be knowledgeable of the requirements of the records management program.

This module describes the records management program for the collection, storage, and maintenance of records. It first describes the scope of the program in terms of quantity of records and numbers of record types. It then describes the elements of the program which include receipt, indexing, storage, retrieval, and disposition. Integral with these descriptions are typical quality control checks which verify quality of records and adequacy of practices for processing and storing records.



## MODULE PREREQUISITES

All of the previous modules of this course should have been completed before proceeding to this one.



## OBJECTIVES

Upon completion of this module, the student/trainee can:

1. Define the term "records" as it pertains to the collection, storage, and maintenance of records for nuclear power plants.
2. State four acceptance criteria for determining record quality.
3. State two classifications of records as required by the Nuclear Regulatory Commission and describe the significance of each classification with respect to records storage.
4. Describe the role of indexing with respect to the records management program.
5. Describe the role of a separate, remote, duplicate record storage areas.
6. Describe environmental controls and filing practices typically used in records storage facilities.
7. Name two features of the records storage system which are subject to internal audits.



# SUBJECT MATTER

## SCOPE OF RECORDS MANAGEMENT

### Definition

For nuclear power plants, records are defined as "those records which furnish documentary evidence of the quality of items and of activities affecting quality; a document is considered a quality assurance record when the document has been completed." This definition includes as records considerably more than data forms which are completed by inspection and test activities. It includes all documents necessary to characterize the quality of items by inference or result. For example, a drawing characterizes the inferred quality of an item and inspection and test records characterize the results of such inspections and tests. The definition of records also includes documentary evidence of activities affecting quality. Continuing the foregoing example, procedures governing drawing preparation, approval, and release are records as are procedures governing performance of inspections and tests.

### Record Types

Types of records can be considered in many ways. Records can be grouped by their purpose, format, material, and other means. In order to clarify the scope of records management programs, a discussion on types of records, grouped by general purpose of the records, is appropriate. General purposes of records can be grouped as (1) specifying item characteristics to be met, (2) stipulating who does what, when, where, and how, (3) documentary results of inspection, tests and verifications and (4) providing indirect but supporting evidence of quality.

Records which specify item characteristics to be met are primarily specifications, drawings, and technical procedures. These documents set forth the design of the item and all subsequent technical requirements to be met by the activities of procurement, fabrication, construction, operation, and maintenance. The products of the design activity are specifications, drawings, and procedures which characterize items on paper. These documents are used and amplified by supplementary specifications, drawings, and procedures in each of the foregoing activities. Thus, this category of records includes design, procurement, fabrication, construction, operation and maintenance documents which set forth on paper the characteristics to be displayed by items represented by each document.

Records which stipulate who does what, when, where, and how are procedures and instructions which, in turn, may require use of specifications and drawings as an integral part of the procedure or instruction. Such procedures and instructions are developed and implemented by each activity affecting quality. Each organization who performs activities governed by one or more of the eighteen quality assurance criteria of 10CFR50, Appendix B is required to have procedures and instructions which describe the activities. These procedures and instructions provide documented evidence of activities affecting quality and are therefore considered to be records.

Records which document results of inspections, tests, and verifications include a wide variety of records. These records are generated by fabricators, constructors, operators, and maintenance organizations. They document as-built item characteristics for everything from material properties to performance in service.

Records which provide supporting evidence of quality include those which document qualifications, audits, independent analyses and tests, item performance reports, and records of supporting activities such as shipping, handling, and storage. Qualification records provide evidence of qualifications of procedures, personnel and equipment, where such qualification is required and its records include quality assurance audit reports and responses thereto. Independent analyses and tests records include results of engineering analyses or special product tests which serve either as independent checks on quality or "referee" decisions on disputed issues. Item performance reports include a variety of quantitative and qualitative reports which provide information on trends, reliability, or other performance measures.

The foregoing discussion of record types is intended merely to indicate the large variety of records. A discussion on records materials would identify types by bound items, 8½" x 11" paper forms, 8½" x 16" forms, drawings of at least four sizes and using at least three different materials as masters, radiographs, strip charts, circular charts, ink tracings, heat tracings, and others. It should be obvious that many types of records exist for the nuclear power plant. It is realistically estimated that there are 2000 record types which must be handled by the nuclear plant owner's records management system.



### Record Classes

Records required by the Nuclear Regulatory Commission to be retained are classified as either lifetime or non-permanent. Lifetime records must be retained by the owner for the life of the particular item represented while it is installed in the plant or stored for future use. Lifetime records are those which meet any of the following criteria:

- records which would be of significant value in demonstrating capability for safe operation.
- records which would be of significant value in maintaining, reworking, repairing, replacing, or modifying the item.
- records which would be of significant value in determining the cause of an accident or malfunction of an item.
- Records which provide required baseline data for the inservice inspection program.

Nonpermanent records are those which show evidence that an activity was performed in accordance with the applicable requirement but which do not meet the criteria for lifetime records. Retention periods are established for nonpermanent records which range from one year to about six years.

Guidelines on categorization of records including suggested retention periods are given by American National Standard ANSI A145.2.9, "Requirements for Collection, Storage, and Maintenance of Quality Assurance Records for Nuclear Power Plants." This standard is typically adopted via licensing commitments.

In addition to records required by the NRC to be retained, utilities typically place additional records into the records management program. Such additional records are those

representing plant systems which are not safety-related systems. Such records are used for essentially the same purposes as NRC required records. Therefore, most utilities have a classification scheme for all records similar to that in Table 31-8-1.

Table 31-8-1  
Typical Utility Records Classification Scheme

| Class                                                                                                                               | Class Description                                                     | Typical Quantity (1) |
|-------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------|----------------------|
| 1                                                                                                                                   | Required by federal, state, and local regulations (2)                 | 8,000,000            |
| 2                                                                                                                                   | Required for efficient station operation, maintenance, administration | 5,000,000            |
| 3                                                                                                                                   | Desirable to retain on a temporary basis                              | 2,000,000            |
| 4                                                                                                                                   | Other (not entered into program)                                      | 5,000,000            |
| NOTE: (1) Typical quantity at beginning of operational phase in number of pages.<br>(2) Includes lifetime and nonpermanent records. |                                                                       |                      |

### Quantity of Records

The volume of records has steadily grown in recent years. As illustrated in Figure 31-8-1, twenty-five million pages of records can be generated by the design, procurement, and construction phases. In addition, the operations phase adds some thirty thousand pages of records per year.

Number of  
pages by  
millions

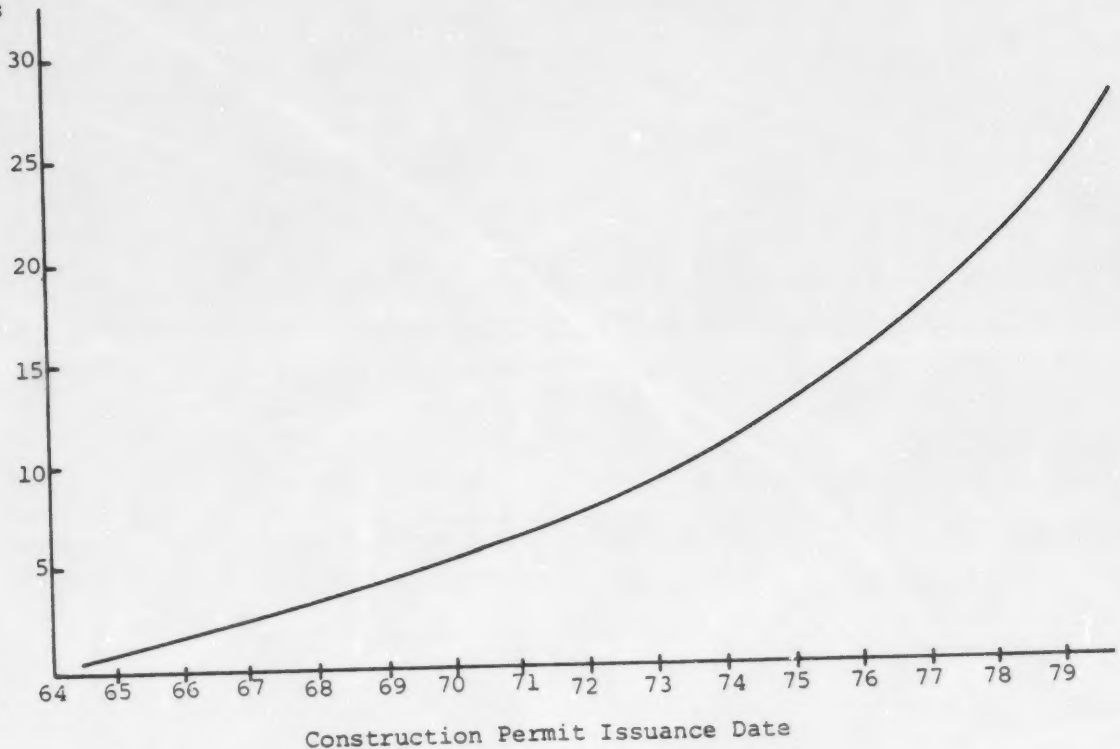


Figure 31-8-1 Design and Construction Documents  
Versus Construction Permit Issuance  
Data

#### Owner Responsibility

The Nuclear Regulatory Commission requires each licensee of nuclear power plants to collect and maintain at the plant site or available thereto sufficient records to document the design, as-built condition, and performance of all safety related plant systems. This regulatory body requires the licensee to collect from the numerous contractors many of the records previously described. Because each contractor tends to use somewhat different records systems, the records management problem is further complicated. However,

it is the responsibility of the owner of the nuclear facility to inspect, classify, and index received records and to reject such records if inadequate.

#### Elements of Records Management Program

The records management program is comprized of five elements: receipt, indexing, storage, retrieval, and disposition. As indicated by these elements, records management deals with completed records and not with the generation of records. All other activities of the quality assurance program generate records. Once records have served their immediate need within the generating activity, the records are forwarded to point(s) of collection for processing. Processing consists of indexing and storing records so that they are retrievable when needed and for discarding after expiration of designated retention periods.

### THE RECORDS MANAGEMENT PROGRAM

#### General

The records management program is planned and documented by procedures as an integral part of each organization's quality assurance program. These programs include distribution of records through the contracting chain to customers as required by contracts. The owner of the nuclear power plant, by having ultimate responsibility, is faced with the more complicated program in that designated records accumulate at the plant site from a variety of contractors.

Each organization is responsible for implementing a records management program at the earliest practicable time consistent with the work schedule for accomplishing activities. These programs may handle records entirely

manually or may use computerized programs. Each program is required to accomplish two basic objectives: (1) designate the retention period of each record type and (2) permit retrieval of records without undue delay. Retention periods are based on categorization of records as lifetime or nonpermanent. Retrieval of records without undue delay is dependent on adequate indexing, storage, and issue practices.

A "central file" concept finds wide use in providing a records processing system which satisfies the two basic objectives. The central file system is illustrated in Figure 31-8-2. This system provides a central point for the receipt and processing of records. As indicated in the figure, processing includes the elements of (1) receipt, (2) classification, (3) reproduction, (4) indexing, (5) storage, and (6) retrieval/disposal. These processing elements are required of any records management system whether the central file concept is used or not.

#### Receiving of Records

The quality of records is verified at the point of receipt for entry of records into the records management program. While originators of records are responsible for preparing quality records, such quality is checked prior to processing records for storage. As a minimum, records must meet the following criteria:

- legible
- completely filled out
- adequately identifiable to the item involved
- authenticated by stamp, initial, signature, or other means by authorized persons
- dated



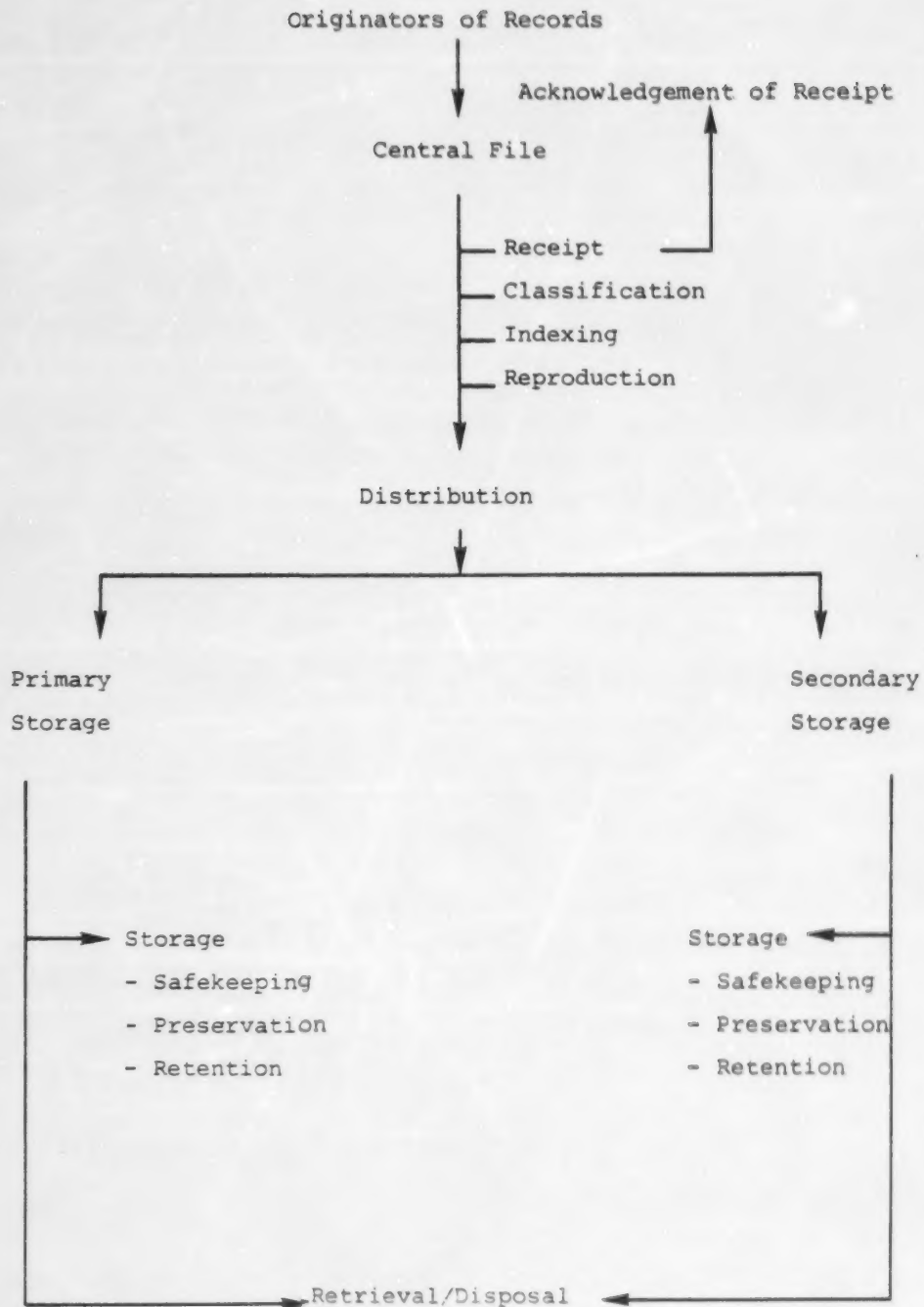


Figure 31-8-2 Central File Records System

The owner's records management program includes procedures for receipt of records. Such procedures designate responsibilities for receiving and inspecting records and for recording which records have been received.

### Classification

Upon receipt of records, the owner shall determine the class of record from criteria such as that listed in Table 31-8-1 previously given.

The classification procedure is necessary to preclude excessive record processing and to assure that only permanent or semi-permanent (important) records are retained and maintained as required by ANSI N45.2.9 "Requirements for Collection, Storage, and Maintenance of Quality Assurance Records for Nuclear Power Plants."

### Indexing

Records to be stored are listed in an index to facilitate retrieval. The method of indexing varies with the particular records storage system used. As a minimum, the location and retention period for each record is recorded.

Whenever a need exists for retrieving a record, the index is consulted to determine the specific location of the record in storage. Experience indicates that a complete description of a record may not be known at the time retrieval is requested. For example, a question might arise pertaining to the original radiograph of a particular weld joint which was made during the construction period. Weld joint number and system nomenclature would be known.

The test of the indexing system would be whether the known identifiers are sufficient to locate the record.

Most utilities index records by a number of indexing parameters to permit record retrieval from a variety of known identifiers. Such an approach permits maximum flexibility in what must be known in order to retrieve a record. However, the number of document identifiers used for indexing adds to the complexity of the system. Manual systems tend to use few document identifiers and therefore offer least flexibility while computer aided systems tend to use more document identifiers and therefore give considerably greater flexibility.

When computer aided retrieval systems are used, the indexing parameters are inputted to the computer memory and a sorting program is used to permit computer identification of the record by any one or combination of the indexing parameters. A typical set of document identifiers for computer aided retrieval systems is illustrated by Figure 31-8-3. Knowledge of any identifier permits computer identification of all records having that identifier. As additional identifiers are known, the list of documents having such identifiers decrease and the time necessary to locate the exact record of concern is reduced.

### Reproduction

The need for reproduction of records depends on the type of storage to be used as received records are termed "hard copy." If the hard copy is to be stored, the only need for reproduction would be those cases where a duplicate storage copy is desired. But if micrographics are to be used, specific reproduction processes are necessary. Thus, the potential reproduction methods include (1) copier machine, (2) roll microfilm, (3) aperture cards, and (4) microfiche. The latter three are specific types of

## DOCUMENT INDEX DATA SHEET

|  |  |  |  |  |  |  |  |  |  |
|--|--|--|--|--|--|--|--|--|--|
|  |  |  |  |  |  |  |  |  |  |
|--|--|--|--|--|--|--|--|--|--|

Film Access Number

| Field No | Descriptor                   | Data |
|----------|------------------------------|------|
| 1        | Record Classification        |      |
| 2        | Document Number              |      |
| 3        | Sheet Number                 |      |
| 4        | Revision Number              |      |
| 5        | Record Type (Name)           |      |
| 6        | Date                         |      |
| 7        | Title                        |      |
| 8        | Cross Reference Number       |      |
| 9        | Purchase Order Number        |      |
| 10       | Vendor Name                  |      |
| 11       | System, Equip. Identifier    |      |
| 12       | Component Type               |      |
| 13       | Serial, Part Number          |      |
| 14       | Location                     |      |
| 15       | Originator (Person, Company) |      |
| 16       | Receiver (Person, Company)   |      |
| 17       | Utility Index Number         |      |
| 18       | Action Required              |      |
| 19       | Keywords                     |      |
|          |                              |      |
|          |                              |      |
|          |                              |      |
|          |                              |      |

Indexer

Checker

Verifier

Audit

Figure 31-8-3 Sample Document Index Data Sheet

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micrographics which have the following advantages over hard copy:

- reduces storage space by as much as 95%
- allows positive control of records
- reduces probability of lost records
- assures archival quality of records.

Each reproduction media has its advantages which tend to make it used for certain types of records. Each media and its typical application are listed in Table 31-8-2. As indicated in the table, certain records do not lend themselves to reproduction and are therefore stored as hard copy.

As previously indicated in Figure 31-8-2, duplicate records are desirable. One set is used as the "working file" from which records are retrieved for use as needed. The other set is a nonworking file whose purpose is to be available for reproduction in the event the working file record is lost or damaged to an extent that it is not useable. Nonetheless, Table 31-8-2 indicates that certain records are either not reproducible or so subject to change as to warrant storage of the hard copy. As described later in this module, the storage system has levels of protection based on whether duplicates are available.

When micrographics are used, two sets of micrographics are typically made and the hard copy is then destroyed. Prior to destruction of the hard copy, it must be positively ascertained that quality micrographics have been made. Process control for micrographics is typically that, illustrated by Figure 31-8-4. As indicated by the figure, hard copies are retained until the micrographics are developed, inspected for quality, and verified as completely reproducing that hard copy. The initial filming produces two originals where possible, e.g., double roll with simultaneous exposure. Both originals are verified. Reproduction



Table 31-8-2  
Reproduction Media

| Type                | Application                                                                                                                                                                                                                                   | Limitations                                                                                                                       |
|---------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|
| 16mm Roll Microfilm | Standard width records of any length which are not utilized. Approximately one file drawer of hard copy can be placed on one roll. Provides duplicate rolls and 40 year archival quality. Examples, inspection report, strip chart recording. | Limited to records of about 14" or less in smallest dimension; does not permit easy revision of documents which have been filmed. |
| Microfiche          | Unitized documents such as manuals and safety analysis reports. Facilitates rapid revision of documents.                                                                                                                                      | Requires retention of master hard copy for easy incorporation of revisions.                                                       |
| Aperture Cards      | Drawings of all sizes and other large dimensioned documents.                                                                                                                                                                                  | Hard copy master must be retained for easy incorporation of revisions.                                                            |
| Hard Copy           | Documents not suitable for micrographics due to size, marginal quality, or nature of record. Example, radio-graphs.                                                                                                                           | Large storage space.                                                                                                              |

of one of the originals is necessary only where satellite working files are also to be maintained.

### Storage

The records management program must include written procedures for the storage of records. These procedures must (1) describe the storage area, (2) describe the filing system, (3) identify the method for verifying that records received for storage agree with the transmittal document and are in good condition, (4) prescribe rules for access to and control of the files, (5) prescribe rules for control

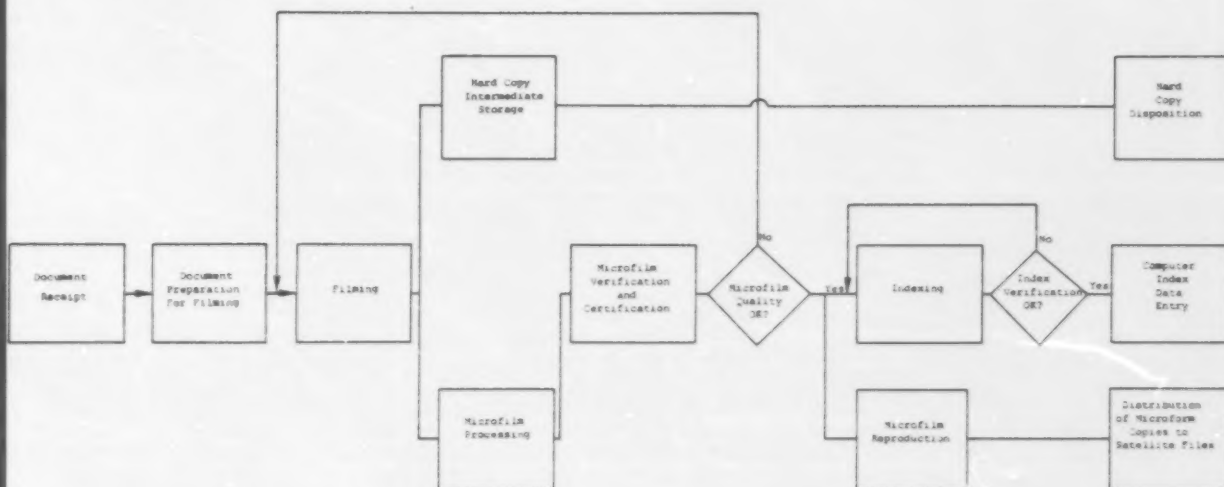


Figure 31-8-4 Document Processing for Micrographics Reproduction

and accountability of records removed from file, and  
(6) provide instructions on disposing of superseded records.

The storage area and specific conditions for storage must preclude deterioration of records for their full period of storage. For lifetime records, this requires preserving the record for as much as forty years. In general, storage areas include protection from condensation and storage of records in a manner suitable for the nature of the record. Condensation is typically avoided by heating and ventilation to maintain the storage area above the dew point. Air conditioning may be necessary for humidity control based on local circumstances. Records are not stored loose. Hard copy records are attached in binders or placed in folders or envelopes for storage on shelving in

containers. Special records which are sensitive to light, pressure, or temperature such as radiographs, micrographics, and photographs are stored in packages or containers recommended by manufacturer's of the materials.

Additional considerations for storage areas include consideration of protection against fire, flooding, tornadoes, insects, and rodents. The extent of controls in these areas is dependent on whether duplicate records are kept at separate, remote locations. Fire protection is provided by constructing the records storage area of materials which give it a four hour fire rating and by prohibiting ignition sources in the primary or permanent records storage area. Additionally, a fire suppression system is typically installed unless duplicate records are maintained elsewhere. For those special records, where duplication is not practicable, special storage containers within the storage area may provide ample protection. For example, radiographs may be stored in light proof envelopes which are placed in special metal containers designed for storage of radiographs.

Controls are established for records storage areas to guard against loss of records. These controls typically include (1) designation of those persons authorized to retrieve records, (2) locking, and possibly alarming, access portals when the area is unattended by authorized persons, and (3) controls over the issuance of records from storage. With regard to issue of records from storage, controls typically include a sign out system as a minimum. Additional controls depend on such factors as whether duplicates exist, whether a copy can be made for issue, and whether the record can be used without its leaving the storage area.

### Retrieval/Disposition

The records arrangement system must provide for retrieval of records without undue delay. The extent of acceptable delay is a judgement of consideration. If the exact record is known, a good system would promptly retrieve that record. But if few record identifiers are known, some time is required to sort through all possibilities to find the exact record. An analogy is finding cancelled personal checks from among last year's checks. If you file the checks in numerical order and want to find a given numbered check, it would not be too difficult. But, if you want to find a check to a given payee and you have no idea what number or date applies, it would be rather time consuming. However, in the latter case, if you have also indexed checks by payee, it would become much easier again.

Disposition of nonpermanent records occurs at the end of their retention periods. Until confidence is gained in the designated retention periods, management may require their approval to destroy records as the first few storage expiration dates are reached. Otherwise, designated persons periodically purge storage areas of those nonpermanent records which have lived past their retention period.

### Audits

Periodic audits of the records management system are required. These audits may be part of the quality assurance internal audit program and are required to check the following:

- received records are available and in designated storage areas.
- storage facilities are in good condition and temperature and humidity controls and other protective devices are functioning properly.

- documents are not deteriorating due to improper storage practices or rough handling.
- documents or copies thereof are legible and identifiable
- documents are properly indexed and retrievable
- personnel performing record management activities are competent and knowledgeable of requirements.



## EXERCISES

1. Describe the roles of each principal element of the records management system by completing the right hand column:

| <u>Element</u>     | <u>Role</u> |
|--------------------|-------------|
| Receiving          |             |
| Classification     |             |
| Indexing           |             |
| Storage            |             |
| Retrieval/Disposal |             |

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2. List five acceptance criteria for determining the quality of records.
3. Describe typical environmental controls and records filing practices in a records storage facility.
4. Audit a records storage facility as outlined in the Procedures section of this module, and prepare a report on the audit.



## MATERIALS

Reference copy of ANSI N45.2.9  
Copies of typical records.



## PROCEDURES

As requested in Exercise 4 of this module, perform the following:

1. Audit a records storage facility at your institution or site. Check practices in the following areas:
  - a. receipt of records for storage
  - b. classification

- c. indexing
  - d. filing
  - e. retrieval
  - f. storage facility environmental controls
  - g. storage facility fire protection
2. Prepare a report of the foregoing audit of a records storage facility and discuss reports in class. Include recommendations for improvements and rationale therefore.
3. Obtain a copy of ANSI N45.2.9 and discuss in class the listing of records in the appendix to this standard. Offer rationale for the designated retention periods.



## DATA TABLE

None.



## REFERENCE MATERIALS

ASME, Quality Assurance Requirements for Nuclear Power Plants, ANSI N45.2, the American Society of Mechanical Engineers

ASME, Requirements for Collection, Storage, and Maintenance of Quality Assurance Records for Nuclear Power Plants,

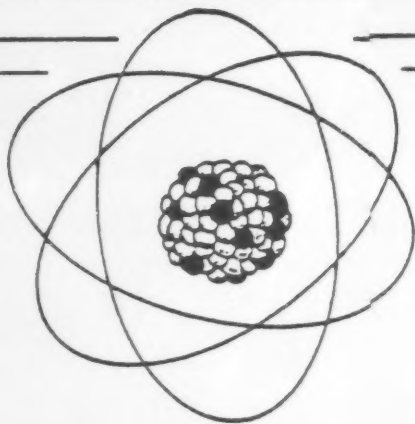
ANSI N45.2.9, The American Society of Mechanical Engineers



# TEST

1. Answer the following questions regarding records as either true or false.
  - \_\_\_\_\_ Any document generated at a nuclear power plant is a "record" and must be placed in a formal records management system.
  - \_\_\_\_\_ "Records" are official documents that can never be destroyed during the life of the power plant.
  - \_\_\_\_\_ A record is a completed document that furnishes evidence of the quality of items and of activities affecting the quality of an item.
2. Records are required to be kept on certain items. Indicate as either true or false whether the following are examples of records.
  - \_\_\_\_\_ A drawing of the item.
  - \_\_\_\_\_ A procedure for testing the item.
  - \_\_\_\_\_ Results of tests on an item.
3. Which of the following criteria must be met when determining the quality of a received record?
  - \_\_\_\_\_ legible
  - \_\_\_\_\_ on 8½" x 11" paper
  - \_\_\_\_\_ dated
  - \_\_\_\_\_ produced by the plant staff
  - \_\_\_\_\_ completely filled out
4. Answer the following as either true or false.
  - \_\_\_\_\_ Records required by the Nuclear Regulatory Commission to be retained are classified as lifetime or non-permanent.
5. Select the most correct statement.
  - (a) Lifetime records may never be destroyed.

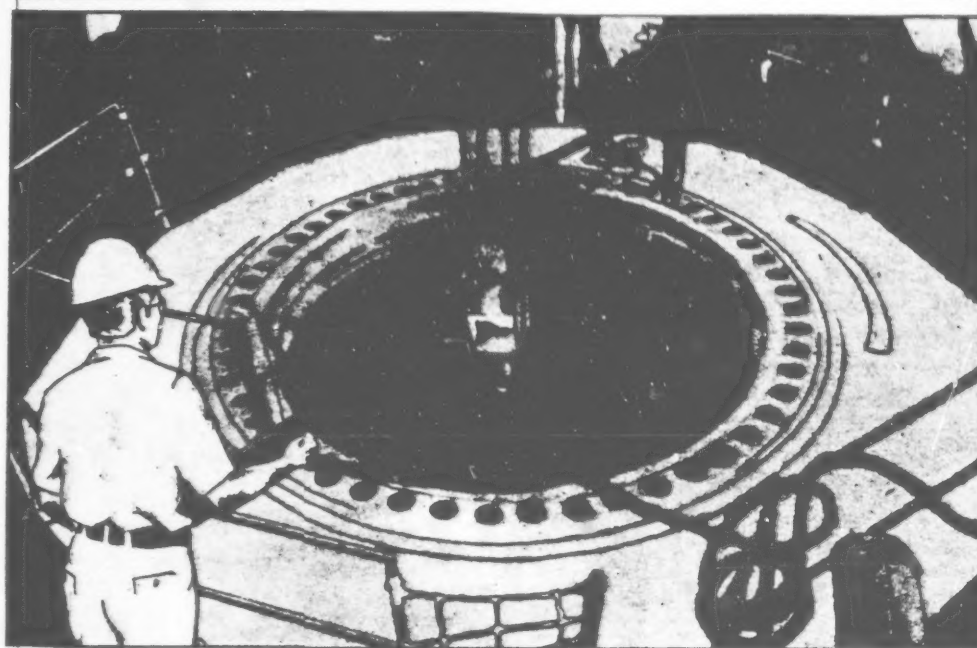
- (b) Lifetime records must be retained for the lifetime of the plant.
  - (c) Lifetime records must be retained for the life of the particular item while it is installed on or stored for future use.
6. Describe the role of the following elements of records management program:
    - a. indexing
    - b. duplicate storage area
  7. Describe environmental controls typically used in a records storage facility.
  8. Describe filing practices typically used in a records storage facility.
  9. Audits are required for the records management program; name two features which are checked by these audits.



# NUCLEAR TECHNOLOGY

## INDEX

COURSE 31 - QUALITY-ASSURANCE PRACTICES



CENTER FOR OCCUPATIONAL RESEARCH AND DEVELOPMENT

4800 LAKEWOOD DRIVE WACO, TEXAS



NUCLEAR TECHNOLOGY SERIES  
INDEX  
for  
COURSE 31, QUALITY-ASSURANCE PRACTICES (EIGHT MODULES)

NOTE: Each module in this Course is numbered separately, and the page numbers begin with page 1 in each module. Therefore, this Index lists for each entry the module number (underlined), followed by a comma and the page number. Figures and tables are listed by their numbers, followed by the module and page number in parentheses. A Master Index is available in a separate volume. This general index merges all index entries from the 35 Nuclear Courses. It is a valuable research tool, with which the student or researcher can locate all the references to any subject within the 35 Courses.

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